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KOMMISSIONEN FOR HAVUNDERSØGELSER

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Nr. 1. Bjarni Sæmundsson: ON THE AGE AND GROWTH OF THE HADDOCK (GADUS ÆGLEFINUS L.) AND THE WHITING (GADUS MERLANGUS L.) IN ICELANDIC WATERS

KØBENHAVN
C. A. REITZEL, BOGHANDEL
BIANCO LUNOS BOGTRYKKERI
1925

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MEDDELELSER FRA KOMMISSIONEN FOR HAVUNDERSØGELSER
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ON THE AGE AND GROWTH OF THE HADDOCK (GADUS ÆGLEFINUS L.) AND THE WHITING (GADUS MERLANGUS L.) IN ICELANDIC WATERS

BY

BJARNI SÆMUNDSSON

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1925

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Introduction.

In the year 1923 I published a paper on the Age and Growth of the Cod (*Gadus callarias* L.) in Icelandic waters[1], based upon investigations into the matter carried out chiefly by the author. In the Introduction to that paper I shortly mentioned that I also had, in addition to that from the Cod, collected material for age determination from Haddock, Whiting, Coalfish and some other food-fishes, and as far as some of them are concerned, already then had published some results of these investigations in my biennial Reports (written in Icelandic) to the Government, while nothing was published about some others. In the time elapsed since then I have collected more material from some of the fishes mentioned in the above referred to paper and added some new, e. g. the Norway Pout, the Lesser Sand-eel and the Capelin to them. By the collecting of material I have partly used my old method of taking it from catches brought ashore by the fishermen partly from fish captured by the Danish Research Steamer, the "Dana", during her two months' cruise in Icelandic waters last summer, under the leadership of the celebrated biologist Dr. Johs. Schmidt, who with his usual generosity gave me permission to provide myself with material necessary for age determination, where I wanted it and allowed me an unlimited use of his research-journals. In connection with this I will mention that I was in the spring of 1923 by the Government and the Legislative Assembly (The Althing) released of my duties as a teacher of the State's College in Reykjavik and thus enabled to devote myself entirely to research work in the life history of our foodfishes. This arrangement has lightened my position to such a degree that I therefore hope to be able to accomplish work I otherwise should have been compelled to drop for ever.

Fig. 1. Iceland, with the localities recorded in the present paper and in the author's paper on the Age and Growth of the Cod.

[1] Meddel. fra Komm. f. Havundersøgelser. Serie Fiskeri. Bd. VII. Nr. 3. København 1923.

The fishes I am going to treat on the following pages are the Haddock and the Whiting. The former is a very valuable food fish for the natives, the latter far less important but still captured in considerable quantities by foreign fishermen.

I. The Haddock (Gadus æglefinus L.).

From old times the Haddock (Icel. Ýsa) has been one of the favourite food fishes of the Icelanders, the fish which has been the largest ingredient of the daily freshfish-meals of the fishermen and other people at the sea side, and dried it has been much liked by everybody also in the interior of the country. And besides this it has been cured (split and salted) on a large scale for export, being formerly the second fish (to the Cod) and now the third one (beaten by the herring) as an article of export, and with regard to the catch made by the natives as well, for the total catch of Cod was 82,776 tons, of Haddock 11,400 tons in the year 1920[1]. On account of the importance of this fish for my country I think it quite reasonable to treat it next after the most important of all Icelandic fishes, the Cod.

1. Age and growth determinations.

a. Collection of material.

In my above mentioned paper on the Age and Growth of the Cod I gave an exhaustive account of my way of collecting material for age- and growth determinations of that fish. Now as I just also collected such material from the Haddock at the same time and in the very same places, when it on the whole was available, it would perhaps be sufficient only to refer to that account (p. 5—6); yet this would not give a quite true account, because I did not always get the two fishes at the very same time, and for this reason I find it necessary to give here a full account regarding the Haddock.

In the year 1913 I made a trip to the North coast visiting several places collecting material for age-determination but failed to get any Haddock at all.

In 1915 I went to the North-west-peninsula (see op. cit., p. 5) and collected material at two places, Isafjord on the SW.-side of the Isafjord Deep and Vatneyri on the north-side of Patreksfjord, the southernmost of the inlets on the NW.-coast of the peninsula[2]. At the first-mentioned place I collected material from 33 (medium and small[3]) specimens, caught on long lines (like most other Haddock in question) by open boats at 75—100 m. depth in the Isafjord Deep July 28th to August 4th, and from 78 (medium and large) specimens captured July 31st by motor-boats at 100 m., on the Bardaground, 14 miles off the headlands between the fjords. — At Vatneyri I got 47 specimens of every size, captured at 40—55 m. in the bay outside the fjord, August 14th to 16th.

In the summer of 1916 I visited Olafsvik, a small fishing place on the north coast of Snæfellsnes, and here I collected material from 92 medium-sized fishes caught at 40—50 m. in the Breidafjord July 18th—19th.

In 1917 I stayed for a couple of weeks in July at Eyrarbakki on the South Coast, where I got 200 small- and medium-sized fish caught 2—3 miles offshore, at 70—80 m. by open boats from the place and from the 2—3 miles farther eastward situated place Stokkseyri, and 14 large fish captured by motor-boats off Krisuvikurberg farther west, at 75—110 m. depth. — In the middle of August I moved to Grindavik where I got material from 21 medium-sized fish taken by open boats at 45—55 m., in addition 77 to medium- and small-sized specimens captured in that same place, September 2nd 1916.

[1] Bulletin Statistique des Pêches maritimes. Vol. XI, p. 109. Copenhague 1924.

[2] For further particulars about this and other places mentioned beneath see my above cited paper and Fig. 1.

[3] The terms, small, medium and large are not to be understood in the English commercial sence.

In 1918 I collected material from 334 small- and medium-sized fish at Akranes, caught by open boats on longlines or handlines at 35—50 m. depth in Faxa Bay in the last week of July.

In 1919 I got material from 50 medium-sized and large fish caught by Westman Isles' boats at 50—90 m. in the first half of August.

In 1920 I visited the North- and the East-coast and got material from 47 small- and medium-sized fish at two places in Eyjafjord in the latter half of July, partly caught in eel-seine at 20—0 m. at Svalbardseyri, partly on handlines or long lines at 30—40 m. depth at Hrisey. — From Eyjafjord I moved to Nordfjord, an important fishing an trading station on the East-coast, and got material from 111 fish of all sizes, at 30 m. in the fjord, off the town, or at 40—50 m. in open sea outside the fjord.

In 1923 I revisited the Northwest-coast, where I collected material from 60 medium and large fish while I stayed in Bolungavik, an important fishing station on the SW.-side of Isafjord Deep, in the first half of August. The fish was caught by motorboats at 100—110 m. depth in the mouth of the "Deep" and off Adalvik.

Finally I collected material from 160 small and medium-sized haddock onboard the Danish research-steamer "Dana", taken out of a vast number of fish caught in trawl at 10—50 m. in Skjalfandi Bay on the North-coast in the latter half of July 1924.

In addition to the collecting thus carried out at different places round the coast in the months of July and August, I have taken material from 280 medium and large fishes bought in the Fish market of Reykjavik and captured in different months during the years 1913—1924 in Faxa Bay or its nearest vicinity at 35—100 m. Further I have, thanks to the courtesy of my good friend, Dr. Johs. Schmidt, made an extensive use of measurements of small and medium-sized Haddock carried out under his supervision onboard the Danish research-steamers, the "Thor" and the "Dana", as will be seen later on. The vast material of Haddock-scales, collected in Faxa Bay onboard the "Thor" in 1908 and the Icelandic steam-trawler "Snorri Sturluson" in 1909 has hitherto not fully been examined, nor have I made any use of it, although put at my disposal, for the simple reason that I had no time to treat it as thoroughly as it deserved.

From the above given records it will be seen, that I have collected material for age-determination from specimens of Haddocks as follows:

From the	South coast	from abt.	360	specimens
—	- South-west coast	- -	800	—
—	- North-west coast	- -	220	—
—	- North coast	- -	210	—
—	- East coast	- -	110	—
		Total abt.	1700	specimens.

Upon this material are based the following studies of the age and growth of the Icelandic Haddock and previously I have given a preliminary account of the results of my examining of the greatest part of this material in my Reports to the Government[1]. These investigations of mine are the first attempts made to study the age and growth of the Icelandic Haddock. Later on, in the year 1922, Harold Thompson, the well-known Scottish biologist, published an elaborate and a very suggestive paper (which often will be cited beneath)[2] on the biology of this fish in general, where Haddock from Iceland also is treated, followed by another paper on the same subject in 1924[3]. Save for these two papers nothing has hitherto

[1] Fiskirannsóknir 1915—16, Andvari XLII, p. 97—108.
— 1917—18, — XLIV, p. 68—75.
— 1919—20, — XLVI, p. 64—69.

[2] Problems in Haddock Biology I. Fisheries, Scotland. Sci. Invest. 1922. No. V. (May 1923).

[3] Haddock Biology II. Fisheries, Scotland. Sci. Invest. 1924. No. I. (June 1924).

been written about the matter and unfortunately only very little of the litterature dealing with Haddock-biology in more southern waters has been accessible to me.

b. Material and methods.

For the age-determinations of the Haddock the scales are, as is well known, the best and for collecting the most convenient material. Yet other osseous elements like the coracoids, the pelvic bones, the vertebræ and especially a transversal section of the clumsy claviculæ afford very good objects for the purpose. Also the otoliths can be used, and in the same manner as those of the Cod[1].

The elements I used for reading the age were the scales; yet, especially at the beginning of the investigations I checked the results by using besides the scales the coracoid or other above mentioned

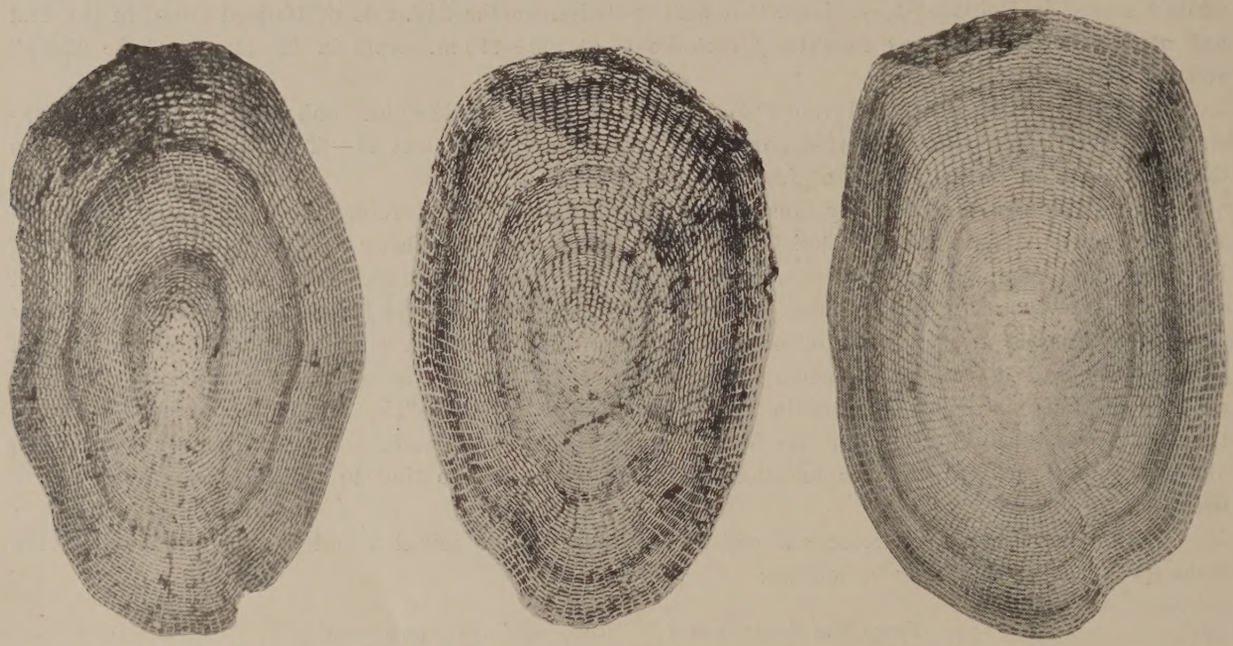

Fig. 2 A. Scale of *Gadus aeglefinus*. II. Gr. 1.-12.-1924. B. Scale of *Gadus aeglefinus*. 44 cm. ♀. III. Gr. Grindavik. 15.-8.-1917. C. Scale of *Gadus aeglefinus*. 54 cm. V. Gr. Stokkseyri. July.

elements. The scales are, in the case of the Haddock, already formed when the fish has attained the length of only 40—45 mm., and the first ones appear on the middle of the sides of the body, having formed 2—3 rows of sclerites at the beginning of August.

Most of the scales used I have taken personally from the fish, put them in paper envelopes, where they have dried instantly. For examining them later on, I have soaked them in pure water and laid them in water between the two usual glasses under the microscope, and then read the age by a twenty fold enlargement. For more minute examination, as counting of the rows of sclerites I have as a rule used fifty fold enlargement.

The reading of the age has usually been very easy, as far as younger (0—6-years old) scales are concerned. Secondary "winter-rings" composed of one or two rows of small sclerites may occur in the summer-zones, but are as a rule easily recognisable and do not cause any trouble. "Blanc" scales[2] have

[1] Cfr. the Author, Age and Growth of the Cod etc. P. 6—7.

[2] ɔ: scales with all sclerites in the first or more growth-zones completely effaced, and formerly regarded as regenerated scales. Now THOMPSON in his above cited paper (1922 p. 13—14) regards such scales as a sign of a metabolism, owing to a lack of calcium content in the blood of the fish, and probably he is quite right. Blanc scales are also very common in the whiting, as will be mentioned beneath.

proved to be very frequent. I have often had some 2—3 and even more in a sample of 6—8 scales lying at once for examination under the microscope ɔ: their frequency can rise to 20—30 % of the number of scales examined. Yet they have not proved to be more frequent in material from the South- and South-west coast, as THOMPSON states, than from other districts. Such blanc scales are impossible for reading the age, but as a rule some of the scales in the sample in question are normal and will give quite reliable reading.

In the above cited paper (1922, p. 13—14) THOMPSON also states that Haddock from the Færoes and from the South Coast of Iceland use to omit the limit between two alternate year zones ("drop the winter ring") and thus give themselves the appearance of being one year younger than they really are. I must say that, as to my experience, this phenomenon is very rare.

While the younger scales can be regarded as pretty easy to read, thin and transparent as they are, and with clearly marked year-zones, this is not always the case with the older ones; their year-zones gradually become narrower, and perhaps divided by secondary-winter-rings and the scales themselves will grow thicker in proportion to their age and thus be more opaque and of a coarser appearance; all this will make the counting of the years more uncertain. Yet in most cases I hope I have succeeded in counting the years with a reasonable accuracy, ɔ: the possible error not being more than one year in case of middle-aged (7—11 years old) scales and two years in the older ones.

As mentioned above, I have in many cases checked the results of my age-reading by the use of other elements; as the coracoids, which are very like those of the cod (cfr. fig. 2 B in my paper on the Age and Growth of the Cod); but especially the claviculæ[1] have proved to be very useful, as they, when cut over in the thickest place in fresh or boiled state, and the surface of the section smoothed by a sharp knife, show to the naked eye or by a very weak enlargement the year-zones very clearly from the very growth centre to the utmost periphery, no matter what is the age. Sometimes I have also used the otoliths (Fig. 6, A, p. 28).

I have, when possible, taken the scales from the middle of the side of the fish, in the vicinity of the lateral line under first or second dorsal; but when the scales, as often is the case with trawl-captured fish are altogether scraped away there, I have taken them where possible. Now THOMPSON[2] has given good evidence as to the fact, that scales from different places of the body of the Haddock, although agreeing with each other as to the number of growth zones, do not so when the proportion between the development of the corresponding zones is concerned, claiming the region below the third dorsal as the best for collecting scales. This circumstance, if not taken into consideration, will influence the results when the length of the fish at the end of each growth-period is to be calculated from the broadness of the year-zones. But as I never have tried to calculate the growth at all, this fact will have no influence on my age-determinations.

Finally it shall be mentioned that I, as regards the youngest age-groups have made an extensive use of the Petersen-method, which proves to do a good service in the case of rapidly growing fish with not very long spawning period.

To these remarks I can add that I always when collecting the material, besides surveying the length of the fish, if possible also have weighed it and examined the fatness, the condition of the reproductive organs and the contents of the alimentary tract, and thus got a fairly good idea of the condition of the fish.

[1] In the literature known to me I have found no attempts to explain the unusual thickness and weight of these and other bones of the shoulder-girdle (the supra-claviculare and the posttemporale) of the Haddock. I am inclined to look upon them as weights which should keep the fish close to the bottom, when it in a sloping position, head down, is searching for its food (small molluscs, worms, sand-eels, etc.) in the soft bottom. On the whole the Haddock seems to keep tight to the bottom and very rarely exhibits any tendency to pelagic life, like some other *Gadus*-species.

[2] Op. cit. 1922, p. 14 etc.

c. Treatment of the material.

In my often mentioned paper on the Age and Growth of the Cod I divided the material into five distinct sections (p. 7). Now I also for the same reason as in the case of the cod find it convenient to treat the Haddock-material in a like manner, for this will make clearer if there is, as THOMPSON already states, any marked difference in the growth and size of the fish at different parts of the coast. For this reason I will devide the coast in the same five sections as before, following the flow of the currents and the consequent fall of the temperature to the right (clockwise) from South to East[1]. The five sections will therefore be these:

α. The South coast, from Eystra Horn to Reykjanes,
β. The South-west coast, from Reykjanes to Breidafjord,
γ. The North-west coast, from Breidafjord to Straumnes,
δ. The North coast, from Straumnes to Langanes,
ε. The East coast from Langanes to Eystra Horn.

α. The South coast.

The material from this section consists of scales from abt. 360 specimens, collected on the western part of the South coast, Westmann Isles—Grindavik in the months of July—August (and from 77 Grindavik-specimens in the beginning of September) during the years 1916, 1917 and 1919. The particulars will be seen from the following Table 1.

This Table includes all the fish examined from the South coast, fish of all ages from two to ten years; unfortunately the 0- and I-group are entirely absent, as fish of these groups are too small-sized to be caught by the gear commonly used for the capture of Haddock by the local fishermen in these districts, the long line. — As to the 0-group it is to be recorded, that it, at the time in question, ɔ: the beginning of August, has in these tracts changed its living, has begun the bottom-life at depths from 70 to 80 m.[2] At this time the young fishes must have attained the length of 3—7 cm and the mean size of abt. 5 cm. — The I-group is, as mentioned above, only occasionally caught on lines at this time owing to the smallness of the fish in spite of its (rather irregular) presence in places with 20—40 m. depth, where older fish (II—IV-gr.) usually are caught. For this reason I have not succeeded in getting material for examining. On the other hand SCHMIDT has taken a great number of the I-group off Ingolfshöfdi, at 48—75 m. together with larger fish, at the end of May (Catch-record D, p. 25). This fish ranged in length from 13 to 23 cm., the mean size being abt. 17 cm. Two months later the average size should be increased to abt. 20 cm which figure could be taken as the mean size of the I-group on the South coast on the whole, at the beginning of August. The annual increase would thus be abt. 15 cm. — As to the older age-groups, the particulars will be seen in the Table, yet the groups older than five years are pretty poor[3]. The II-group is the most numerous; it ranges in length (both sexes taken together) from 24 to 36 cm., the mean size 30,7 cm. and the average annual increase should be abt. 11 cm. But as the greater part of the fish belonging to this group is caught pretty late, viz. the 2nd of September, the average size must be a little lesser, say 30 cm. — The III-group ranges from 37 to 52 cm., the average length 42,2 cm. and the annual increase abt. 12,0 cm. — The IV-group ranges from 40 to 57 cm.; average length 49,0 and the annual increase 6,8 cm. — The V-group ranges from 46 to 69 cm., average size 54,9 cm., annual increase 5,9 cm. — The VI-group is rather scarce and varies in size from 55 to 70 cm., average length 64,1 cm.

[1] Unfortunately my five divisions of the Coast do not cover or coincide with any of THOMPSON's four divisions (see his: Haddock Biology II. Chart No. 8, p. 33.

[2] Cfr. SCHMIDT: Fiskeriundersøgelser ved Island og Færøerne i Sommeren 1903, Skrifter udg. af Komm. for Havundersøgelser, No. 1. København 1904, p. 82—83 and the author: Oversigt over Islands Fiske. Skrifter udg. af Komm. f. Havundersøgelser, No. 5. København 1909, p. 50.

[3] As they have moved to deeper water or the more distant feeding grounds.

Table 1. Haddock from the South coast. Westman Isles, August 1919; Stokkseyri and Eyrarbakki, July 1917; Grindavik, Sept. 1916, August 1917.

Age group	II		III		IV		V		VI		VII		VIII		IX		XI-XII		XIII-XIV	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Length cm.																				
84	..		..		..		..		..		..			1	..		..		..	
83	..		..		..		..		..		..		..		..		..		..	
82	..		..		..		..		..		..		..		..		..		..	
81	..		..		..		..		..		..		..		..			1	..	
80	..		..		..		..		..		..		..		..		..		..	
79	..		..		..		..		..		..			1		1	..		1	
78	..		..		..		..		..		..		1		..		..		..	
77	..		..		..		..		..		..		..		..		..			1
76	..		..		..		..		..		..		..			1	..		..	
75	..		..		..		..		..		..			1	..		..		..	
74	..		..		..		..		..		..		..			1	..		..	
73	..		..		..		..		..		..		..		..		..		..	
72	..		..		..		..		..			1	..			1	..		..	
71	..		..		..		..		..			1	..		1		..		..	
70	..		..		..		..			1	..		..		..		..		..	
69	..		..		..			1	..		..		..		..		..		..	
68	..		..		..		..		..		..		..		..		..		..	
67	..		..		..		..			1	..		..		..		..		..	
66	..		..		..		..		1	3		1	..		..		..		..	
65	..		..		..		..		1		..		..		..		..		..	
64	..		..		..			1	1	2	..		..		..		..		..	
63	..		..		..		..		2		..		..		..		..		..	
62	..		..		..			1	1		..		..		..		..		..	
61	..		..		..		1	3	1		..		..		..		..		..	
60	..		..		..		1	1		..		1	..		..		..		..	
59	..		..		..		1	1		..	..		..		..		..		..	
58	..		..		..		1			..	..		..		..		..		..	
57	..		..			1	4	1	..		..		..		..		..		..	
56	..		..			1	3	3	..		..		..		..		..		..	
55	..		..		1	1	1	3		1	..		..		..		..		..	
54	..		..		2	1	1	4	..		..		..		..		..		..	
53	..		..		2	3		6	..		..		..		..		..		..	
52	..		1		5	12	4	3	..		..		..		..		..		..	
51	..		..		4	8	3	2	..		..		..		..		..		..	
50	..		..		4	4	2	2	..		..		..		..		..		..	
49	..		2		6	3	1	1	..		..		..		..		..		..	
48	..		..		5	11	..		..		..		..		..		..		..	
47	..			1	6	3	..		..		..		..		..		..		..	
46	..		1		4	2	1		..		..		..		..		..		..	
45	..		3	1	3	1	..		..		..		..		..		..		..	
44	..		6	5	4	2	..		..		..		..		..		..		..	
43	..		6	1	..		..		..		..		..		..		..		..	
42	..		5	2	2	1	..		..		..		..		..		..		..	
41	..		5	1		2	..		..		..		..		..		..		..	
40	..		2	5	1		..		..		..		..		..		..		..	
39	..		1	5	..		..		..		..		..		..		..		..	
38	..			5	..		..		..		..		..		..		..		..	
37	..			1	..		..		..		..		..		..		..		..	
36		2	..		..		..		..		..		..		..		..		..	
35		1	..		..		..		..		..		..		..		..		..	
34	1	4	..		..		..		..		..		..		..		..		..	
33	6	5	..		..		..		..		..		..		..		..		..	
32	5	9	..		..		..		..		..		..		..		..		..	
31	14	12	..		..		..		..		..		..		..		..		..	
30	12	7	..		..		..		..		..		..		..		..		..	
29	8	5	..		..		..		..		..		..		..		..		..	
28	2	4	..		..		..		..		..		..		..		..		..	
27		2	..		..		..		..		..		..		..		..		..	
26	2	1	..		..		..		..		..		..		..		..		..	
25	..		..		..		..		..		..		..		..		..		..	
24	1		..		..		..		..		..		..		..		..		..	
23	..		..		..		..		..		..		..		..		..		..	
Average length	30.4	31.1	43.3	40.8	48.3	49.6	54.1	55.4	63.4	64.7	67.2		78.0	79.3	71.0	75.2	81.0		79.0	77.0
	30.7		42.2		49.0		54.9		64.1				79.0		74.4					

and the average annual increase 9,2 cm. (surely too high). — The remaining groups are poorer in number still and give no right idea of the growth (which now becomes ever slower). The VII-group (only females) ranges from 60 to 72 cm. with an average size of 67,2 cm. and an annual increase of 3,1 cm. — The VIII-group (4 specimens only) varies from 75 to 84 cm., average length 79,0 cm. — Finally the IX-group (5 specimens) ranges from 71 to 79 cm., with an average length of 74,4 cm.

The following summary will show all the particulars concerning the Haddock from the South coast, given above, more clearly.

Age groups.....	0	I	II	III	IV	V	VI	VII	VIII	IX
Variation in length	4—7	(14—20)	24—36	37—52	40—57	46—69	55—70	60—72	75—84	71—79
Average length	abt. 5.0	abt. 20.0	30.7	42.2	49.0	54.9	64.1	67.2	79.0	74.4
Average annual increase..	..	abt. 15.0	abt. 10.0	11.5	6.8	5.9	9.2	3.1	..	..

From this summary it will be seen, that the growth displays the usual features, being quickest in the first 3 years, and then, when the maturity commences successively diminished but unfortunately the figures showing the average annual increase are rather irregular, owing to the scarcity of the material available.

β. The South-west coast.

The material from the South-west coast comprises scales from abt. 500 fishes collected, as recorded above mainly in two places, Akranes, where I got the bulk of the Faxa Bay material in the last week of July 1918 and Olafsvik, where the Breidafjord material was collected in the latter half of July 1916. And in addition to this mixed material taken in Reykjavik at different times. The particulars concerning this material (except that from Reykjavik) are given in the following Table 2.

This Table embraces all the material from the South-west coast, except the greater part of that collected at Reykjavik. Here the 0-group is quite absent, as was the case with that group in the Table 1 and for the same reason: no material available, save for some 7 specimens taken partly pelagic in the first half of July, size 2—3 cm., partly on the bottom in the middle of August, size 4,5—8 cm. Besides this Schmidt captured 50 pelagic fry in Faxa Bay, July 12th 1908, <10—50 mm. in length. If 2,5 cm be taken as the mean size of the pelagic fry and 6 cm. of that living on the bottom, the average length of the 0-group at the time concerned should be 5 cm. or nearly so. — The I-group is represented by 30 specimens only, caught in trawl in Faxa Bay as late as the middle of September, for which reason they are no good representatives, being more than one month too old. They vary in length from 23—28 cm., average length 25,5 cm., which would be abt. 4 cm. too much. For comparison I can tell that onboard the "Dana" last summer a great number of Haddock, evidently for the greatest part belonging to the I-group, was caught in Faxa Bay July 6th—7th. The length of this fish varied from 11 to 25 cm., and the mean size was abt. 20 cm.; at the beginning of August they probably would have added 1—2 cm. to that length, and thus the average length of this group should at the time referred to be about 21,5 cm. — The II-group is rather scarce, counting only 18 specimens, ranging in length from 32 to 39 cm., average length 35,7 cm., average annual increase abt. 14 cm. Together with the fish recorded above 2625 Haddocks, evidently belonging to the II-group, were caught onboard the "Dana", ranging from 26 to 39 cm., mean size abt. 35 cm., or only abt. 1 cm. shorter than those caught a couple of weeks later, a good agreement indeed: — The next three groups are better represented; the III-group is the most numerous, 162 specimens ranging from 34 to 50 cm., mean length 41,6 cm., annual increase 6 cm.[1] — The IV-group varies

[1] Of fish apparently belonging to this group 67 specimens were in the above mentioned catch, made by the "Dana". They ranged in length from 41 to 51 cm., with an average size of nearly 46 cm. Full particulars about this very rich and interesting catch will be given beneath (Catch-record E, p. 25).

Table 2. Haddock from the South-west Coast. Olafsvik, July 1916; Akranes, July 1917; Reykjavík, September 1913.

Age groups	I		II		III		IV		V		VI		VII		XII	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Length cm.																
82	..		..		..		..		..		..		..		1	
81			..		..		..		..		..		..		..	
80	..		..		..		..		..		..		..		..	
79	..		..		..		..		..		..		1		..	
78	..		..		..		..		..		..		..		..	
77	..		..		..		..		..		..		..		..	
76	..		..		..		..		..		..		..		..	
75	..		..		..		..		..		..		1		..	
74	..		..		..		..		..		..		1		..	
73	..		..		..		..		..		..		..		..	
72	..		..		..		..		..		..		..		..	
71	..		..				..		..		..		..		..	
70	..		..		..		..		..		..		..		..	
69	..		..		..		..		..		..		..		..	
68	..		..		..		..		..		1	1	..		..	
67	..		..		..		..		..			1	..		..	
66	..		..		..		..			1		1	..		..	
65	..		..		..		..			5	..		..		..	
64	..		..		..		..		2	1	..		..		..	
63	..		..		..		..			1		1	..		..	
62	..		..		..		..		2	1	1	3	..		..	
61	..		..		..		..		7	7		1	..		..	
60	..		..		..			1	5	7	1	2	..		..	
59	..		..		..			1	1	7		1	..		..	
58	..		..		..		..		10	4		2	..		..	
57	..		..		..		1	2	12	6	..		..		..	
56	..		..		..		2	1	5	5	..		..		..	
55	..		..		..			1	14	6	..		..		..	
54	..		..		..		1	4	9	4	..		..		..	
53	..		..		..		2	7	3	4	..		..		..	
52	..		..		..		3	4	3	6	..		..		..	
51	..		..		..		6	4	4		..		..		..	
50	..		..		1		5	7	2	2	..		..		..	
49	..		..			1	4	3	..		..		..		..	
48	..		..		..		2	3	..		..		..		..	
47	..		..		2	1	1	1	..		..		..		..	
46	..		..		1		1	1	..		..		..		..	
45	..		..		8	9	1	2	1		..		..		..	
44	..		..		4	4		1	..		..		..		..	
43	..		..		6	9	..		..		..		..		..	
42	..		..		14	19	1		..		..		..		..	
41	..		..		23	16	1	2	..		..		..		..	
40	..		..		17	13	..		..		..		..		..	
39	..		2	2	3	3	..		..		..		..		..	
38	..		..		3	3	..		..		..		..		..	
37	..		2	3	1		..		..		..		..		..	
36	..		1	1	2		..		..		..		..		..	
35	..		..		..		..		..		..		..		..	
34	..		1		1	1	..		..		..		..		..	
33	..		2	2	..		..		..		..		..		..	
32	..		2		..		..		..		..		..		..	
31	..		..		..		..		..		..		..		..	
30	..		..		..		..		..		..		..		..	
29	..		..		..		..		..		..		..		..	
28	1	2	..		..		..		..		..		..		..	
27	3	2	..		..		..		..		..		..		..	
26	2	3	..		..		..		..		..		..		..	
25	5	2	..		..		..		..		..		..		..	
24	4	3	..		..		..		..		..		..		..	
23		2	..		..		..		..		..		..		..	
22	..		..		..		..		..		..		..		..	
Average length	25.5	25.4	35.2	36.4	41.5	41.8	50.1	51.0	56.3	57.7	63.3	62.0	75.0	76.5	82.0	
	25.4		35.7		41.6		50.6		56.9		62.3		76.0			

in length from 41 to 60 cm.; average length 50,6 cm. and the annual increase 9,0 cm. — The V-group ranges from 45 to 66 cm.; mean size 56,9 cm. and the annual increase 6,3 cm. — The VI-group is again pretty poor, 16 individuals only, which range from 58 to 68 cm., mean size 62,3 cm. and the annual increase 5,4 cm. The following groups are too scarce for further consideration.

The particulars concerning the Haddock from the South-west coast, given in the Table 2 and in the remarks added to the Table will be more clearly noticeable from the following summary.

Age groups	0	I	II	III	IV	V	VI	VII
Variation in length	2.5—8	11—25	26—39	34—50	41—60	45—66	58—68	74—79
Average length	abt. 5.0	abt. 21.5	abt. 35.0	41.6	50.6	56.9	62.3	76.0
Average annual increase	..	abt. 16.0	abt. 15.0	6.0	9.0	6.3	5.4	..

If the figures in this summary, especially those indicating the average length are compared with the corresponding ones for the South coast (Table 1, p. 9) no remarkable difference in the size of the corresponding year-groups is noticeable, as if the growth was much the same in both cases, unlike what is the case with the Cod[1] in these tracts. But perhaps some difference would however be stated, if larger material, collected at the same time in both districts was examined or the mean sizes were calculated from the scales, which has not hitherto been practised. On the other hand certain irregularities regarding some of the figures are conspicuous, but these probably are due to an insufficient material and would be eliminated by examining a larger one.

I mentioned above, that I had collected some material from Faxa Bay and its nearest vicinity at different times of the year during a rather prolonged period. As this material is pretty heterogenous and not comparable with that dealt with above, it was impossible to treat it together with this. But nevertheless I find it justifiable also to give some account of it, although separately in the following Table[2].

As the material displayed in this Table is, as far as the particular year-groups are concerned, both collected troughout a rather long part of the year and pretty scarce I find no reason for any further considerations as to the variation in length, mean size etc. I shall rest satisfied with referring to the figures in the Table and mentioning that most of the specimens of the I-group are surveyed in the months of September—November, those of the II-group in August—November, those of the III-group in July—October, those of the IV-group in May—June and the remainder in January—March. Although taken at so different times of the year the single specimens of the material obviously arrange themselves (except the VII-group where a little digression is noticeable) along side the parabolic line, which is the common graphical expression for the growth of fishes (cfr. the Graph, p. 20)[3].

γ. The North-west coast.

The material from this section embraces scales from abt. 220 specimens, collected, as recorded above on the North-west coast, Patreksfjord—Isafjord Deep, mainly in the first half of August 1915 and 1923. The particulars are displayed in the following Table 4.

This Table embraces all the fish examined from the North-west coast; a fairly representative material as the particular age-groups are pretty well represented up to "old age", save for the two youngest which as else are quite absent and for the same reason: no specimens available. — As to the 0-group I took 2 specimens, 5,0 and 7,5 cm. by eel-seine, and 4 pelagic ones 2—3 cm. long in the middle of July

[1] Cfr. Age and Growth of the Cod. etc. p. 27.

[2] In this Table are included the specimens of the I-group and II-group recorded in the Table 2, and some few from the western part of the South coast, captured in the months February—April.

[3] In accordance with the fact, that the fish in each year-group is taken at very different times of the year, one of the most outstanding features of this Table is the wide-ranging variation in length of the individuals of many of the groups.

Table 3. Haddock from the South-west coast. Faxa Bay and Midnes Sjór, all the year round.

Age groups	0	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
Sex	♂ ? ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀
Length cm.															
84	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
83	..	..	..	..	..	..	..	..	..	..	..	1	..	1	.
82	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..
81	..	..	..	..	..	..	..	..	..	1	1 1	..	..	..	..
80	..	..	..	..	..	..	..	..	..	1	..	1	..	..	1
79	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
78	..	..	..	..	..	..	..	..	..	..	..	..	..	1 2	..
77	..	..	..	..	..	..	..	1	1	1	2	1	2	..	..
76	..	..	..	..	..	..	..	1 1	..	1	..	1	1	..	..
75	..	..	..	..	..	..	..	1	..	..	..	1	..	..	..
74	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
73	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
72	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..
71	..	..	..	..	..	..	2	..	1	1 2	..	..	..	..	..
70	..	..	..	..	..	..	..	..	1 1	1	..	..	..	.	..
69	..	..	..	..	..	1	..	1	..	1 1	..	..	..	..	..
68	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
67	..	..	..	..	..	1 2	..	..	1	..	..	..	..	..	.
66	..	..	..	..	..	2	..	..	..	..	..	..	.	..	
65	..	..	..	..	..	3	1	..	..	..	..	..	..	..	.
64	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
63	..	..	..	..	1	..	2	..	..	1	..	..	..	..	..
62	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..
61	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
60	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..
59	..	..	..	..	..	2 1	1	..	..	..	..	..	..	..	..
58	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
57	..	..	..	1	1 1	2	1	..	..	..	..	..	..	..	.
56	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..
55	..	..	..	..	1 2	2	1	..	..	..	..	..	..	..	..
54	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..
53	..	..	..	2	1 2	1	..	..	..	..	..	..	..	..	..
52	..	..	..	..	2 1	..	..	..	..	..	..	..	..	..	..
51	..	..	..	1 2	2	..	..	..	..	..	..	..	..	..	..
50	..	..	..	2 3	1	..	..	..	..	..	..	..	..	..	..
49	..	..	..	1 3	3	..	..	..	..	..	..	..	..	..	..
48	..	..	..	1 4	..	..	..	..	..	..	..	..	..	..	..
47	..	..	..	3 6	1 2	..	..	..	..	..	..	..	..	..	..
46	..	..	..	6 3	1	..	..	..	..	..	..	..	..	..	..
45	..	..	1 2	4 4	..	..	..	..	..	..	..	..	..	..	..
44	..	..	..	3 5	..	..	..	..	..	..	..	..	..	..	..
43	..	..	1	5 3	..	..	..	..	..	..	..	..	..	..	..
42	..	..	1	3 1	..	..	..	..	..	..	..	..	..	..	..
41	..	..	3 1	1 5	..	..	..	..	..	..	..	..	..	..	..
40	..	..	3 2	1 2	..	..	..	..	..	..	..	..	..	..	..
39	..	..	5 3	3 2	..	..	..	..	..	..	..	..	..	..	..
38	..	..	3 6	..	..	..	..	..	..	..	..	..	..	..	..
37	..	..	1 1	1	..	..	..	..	..	..	..	..	..	..	..
36	..	..	2 5	..	..	..	..	..	..	..	..	..	..	..	..
35	..	..	3 1	..	..	..	..	..	..	..	..	..	..	..	..
34	..	..	3 2	..	..	..	..	..	..	..	..	..	..	..	..
33	..	..	2 1	..	..	..	..	..	..	..	..	..	..	..	..
32	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.
31	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
30	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	..	3 3	..	..	..	..	..	..	..	..	..	..	..	..	..
27	..	5 4	..	..	..	..	..	..	..	..	..	..	..	..	..
26	..	2 4	..	..	..	..	..	..	..	..	..	..	..	..	..
25	..	7 3	..	..	..	..	..	..	..	..	..	..	..	..	..
24	..	5 3	..	..	..	..	..	..	..	..	..	..	..	..	..
23	..	1 2	..	..	..	..	..	..	..	..	..	..	..	..	..
:	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
:	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
:	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Average length	15.0 / 15.0	25.6 / 26.0 / 25.8	36.7 / 37.0 / 36.8	41.1 / 44.3 / 44.2	53.7 / 51.4 / 52.2	58.1 / 61.2 / 60.2	62.1 / 61.7 / 62.0	70.2 / 74.5 / 71.4	69.8 / 73.5 / 70.8	73.2 / 72.1 / 72.6	76.0 / 77.3 / 76.8	83.0 / 77.7 / 78.3	75.7	77.0 / 79.0 / 78.5	79.0

Table 4. Haddock from the North-west coast. Patreksfjord and Isafjord, July—August 1915; Bolungavik, July 1923.

Age groups	II		III		IV		V		VI		VII		VIII		IX		X		XI		XII		XIII		XIV	
Sex	♀	♂	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Length cm.																										
87	..		..		..		..		..		..		..		2		..		..		..		..		1	
86	..		..		..		..		..		..		..		..		..		..		..		..		..	
85	..		..		..		..		..		..		..		..		..		1		..		..		..	
84	..		..		..		..		..		..		..		..		1		..		..		..		..	
83	..		..		..		..		..		..		1		..		..		1		..		1		..	
82	..		..		..		..		..		..		..		1		..		..		..		..		..	
81	..		..		..		..		..		..		..		2		1		..		..		..		..	
80	..		..		..		..		..		..		1		..		1		..		..		..		..	
79	..		..		..		..		..		..		1		..		1		1		..		..		..	
78	..		..		..		..		..		..		..		2		1		..		..		..		..	
77	..		..		..		..		..		..		2		1	3	..		..		..		..		..	
76	..		..		..		..		..		..		1		1		1		..		..		..		..	
75	..		..		..		..		..		1		3		1	1	1		..		..		..		..	
74	..		..		..		..		..		1		..		..		2		..		..		..		..	
73	..		..		..		..		..		1		2	4	2	1		1	..		..		..		..	
72	..		..		..		..		..		..		1	2	1	1	..		..		..		..		..	
71	..		..		..		..		..		1	2	1	1	..		..		..		..		..		..	
70	..		..		..		..		..		1		3	1	..		..		..		..		..		..	
69	..		..		..		1		..		..		1		..		..		..		..		..		..	
68	..		..		1		..		1		..		1		..		..		..		..		..		..	
67	..		..		..		1		1		1	1	..		..		..		..		..		..		..	
66	..		..		..		2		1	4	1	2	..		..		..		..		..		..		..	
65	..		..		..		1		1		1		1		..		..		..		..		..		..	
64	..		..		..		1		1		..		..		..		..		..		..		..		..	
63	..		..		..		1		1		..		..		..		..		..		..		..		..	
62	..		..		1	1	4	1	..		1		..		..		..		..		..		..		..	
61	..		..		..		2	1	..		..		..		..		..		..		..		..		..	
60	..		..		1		3	2	..		1		..		..		..		..		..		..		..	
59	..		..		1		2		..		..		..		..		..		..		..		..		..	
58	..		..		2		..		..		..		..		..		..		..		..		..		..	
57	..		..		3		..		..		..		..		..		..		..		..		..		..	
56	..		1		1		..		..		..		..		..		..		..		..		..		..	
55	..		..		1	2	1		..		..		..		..		..		..		..		..		..	
54	..		..		1	1	..		..		..		..		..		..		..		..		..		..	
53	..		1		2		..		..		..		..		..		..		..		..		..		..	
52	..		1		2	2	..		..		..		..		..		..		..		..		..		..	
51	..	1			1	3	..		..		..		..		..		..		..		..		..		..	
50	..		7		2	3	..		..		..		..		..		..		..		..		..		..	
49	..	2	4		1		..		..		..		..		..		..		..		..		..		..	
48	..	4	4		1		..		..		..		..		..		..		..		..		..		..	
47	..	2	3		..		..		..		..		..		..		..		..		..		..		..	
46	..	4	2		..		..		..		..		..		..		..		..		..		..		..	
45	..	4	1		1		..		..		..		..		..		..		..		..		..		..	
44	..	1	2		..		..		..		..		..		..		..		..		..		..		..	
43	..	1	3	1			..		..		..		..		..		..		..		..		..		..	
42	..	2	2		..		..		..		..		..		..		..		..		..		..		..	
41	..		1		..		..		..		..		..		..		..		..		..		..		..	
40	..	1	1		..		..		..		..		..		..		..		..		..		..		..	
39	..		..		..		..		..		..		..		..		..		..		..		..		..	
38	..	1	1		..		..		..		..		..		..		..		..		..		..		..	
37	..	1			..		..		..		..		..		..		..		..		..		..		..	
36	..		..		..		..		..		..		..		..		..		..		..		..		..	
35	2	1	..		..		..		..		..		..		..		..		..		..		..		..	
34	1	4	..		..		..		..		..		..		..		..		..		..		..		..	
33	1	1	..		..		..		..		..		..		..		..		..		..		..		..	
32	2	1	..		..		..		..		..		..		..		..		..		..		..		..	
31	1		..		..		..		..		..		..		..		..		..		..		..		..	
30	1	1	..		..		..		..		..		..		..		..		..		..		..		..	
29	2	1	..		..		..		..		..		..		..		..		..		..		..		..	
28	..		..		..		..		..		..		..		..		..		..		..		..		..	
Average length	32.0	32.8	15.6	16.7	52.5	54.1	61.4	62.6	66.2	65.3	66.0	69.5	73.1	73.7	75.3	78.4	77.3	77.5	79.0	84.0			83.0		87.0	
	32.4		46.1		53.7		62.0		65.7		68.3		73.5		77.4		77.4		82.3							

in 1908, and onboard the "Dana" 17, 2,3—4,3 cm., were taken pelagically off this coast July 17th, last summer. At the time referred to the size of the individuals of this group should consequently range from 2,0 to 8,0 cm., and the average size be abt. 5 cm. — Of the I-group I have failed to come across a single specimen in these tracts, where this age-group is so very abundant, when many other fishes are concerned, nor has SCHMIDT had better luck than I, but surely this group will not differ remarkably in size from the corresponding group on the South-west coast. — The II-group is tolerably well represented in the Table and is ranging from 29 to 35 cm., mean size 32,4 cm. and the average annual increase abt. 14,5 cm. if the mean size of the I-group is computed to be abt. 18 cm. — The III-group is the most numerous (numbering 55 specimens), ranges from 37 to 56 cm., mean size 46,1 cm. and the annual increase 13,7 cm. — The IV-group varies from 43 to 68 cm., average length 53,7 and the annual increase 7,6 cm. — The V-group ranges in length from 55 to 69 cm., mean size 62,0 cm., annual increase 8,3 cm. — The VI-group (rather scarce) ranges from 63 to 68 cm., mean size 65,7 cm., annual increase 3,7 cm. — The VII-group varies in size from 60 to 75 cm., average length 68,3 cm., annual increase 2,6 cm. — The VIII-group (pretty numerous) varies from 65 to 83 cm., mean length 73,5, annual increase 5,2 cm. — The IX-group varies in length from 72 to 87 cm.; average size 77,4 cm. annual increase 3,9 cm. — The X-group (comparatively numerous) ranges from 73 to 84 cm., average size 77,4 cm., annual increase 0 cm. — The few individuals of older groups give no reason for further remarks, as their size and age seem to be in reasonable proportion to each other. And on the whole the material displayed in this Table seems to fit fairly well into what could be termed as a normal course of the growth.

The particulars shown in this Table for Haddock from the North-west coast will be more conspicuous if the following summary is glanced at.

Age groups	0	I	II	III	IV	V	VI	VII	VIII	IX	X
Variation in length	2—8	..	29—35	37—56	43—68	55—69	63—68	60—75	65—83	72—87	73—84
Average length	abt. 5.0	abt. 18.0	32.4	46.1	53.7	62.0	65.7	68.3	73.5	77.4	77.4
Average annual increase ...	..	abt. 13.0	abt. 14.5	13.7	7.6	8.3	3.7	2.6	5.2	3.9	0.0

When the figures in this summary, especially those indicating the mean size of the year-groups are compared with the corresponding ones for the South- and the South-west coast, they do not show any slower growth in the North-west district than in the others, except perhaps in the youngest groups; from the third year and upwards the reverse seems to be the case. If there really is any distinct difference[1] more material from all these districts would be needed for demonstrating it by the method here followed.

δ. The North coast.

As recorded previously the material from this district consists of 210 samples of scales collected in Eyjafjord and Skjalfandi Bay in the latter half of July 1920 and 1924. The particulars concerning it are given in the Table 5.

Here, like in the other districts fish of the 0-group is entirely absent, obviously because they still are leading pelagic life at this time in those waters. SCHMIDT took successively abt. 100 specimens at different stations between Langanes and Eyjafjord July 30th—31st on his cruise in the "Thor" 1905[2]. These specimens measured 8—42 mm., mean size probably abt. 2,5 cm. — The I-group is very scarce, only 7 specimens (taken by eel-seine at Svalbardseyri) 17—23 cm. long, mean size 19,3 cm. and average annual increase abt. 17 cm. — The II-group[3] is pretty numerous, ranging from 23 to 32 cm., average

[1] Cfr. THOMPSON: Problems etc. Table 15, p. 66.

[2] According to the journal for that cruise. The contents of the numerous pelagic hauls made onboard the "Dana" last summer, and so rich in fish fry, are unfortunately not known to me at present.

[3] 50 specimens of this group were taken (onboard the "Dana") in Skjalfandi Bay, the remainder at Svalbardseyri. The other groups were taken at Hrisey or in Skjalfandi Bay. In addition to the fish recorded from this bay "Dana" captured (with

Table 5. Haddock from the North coast. Eyjafjord, July 1920; Skjalfandi Bay, July 1924.

Age groups	I			II		III		IV		V		VI		XIV	
Sex	♂	?	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Length cm.															
84	..			..		..		..		..		..		1	
:	..			..		..		..		..		..		..	
58	..			..		..		..		..		..		..	
57	..			..		..		..		..		1		..	
56	..			..		..		..		..		..		..	
55	..			..		..		..		..		..		..	
54	..			..		..		..		1		..		..	
53	..			..		..		..		..		..		..	
52	..			..		..		..			1	..		..	
51	..			..		..			1	..		..		..	
50	..			..		..		2		..		..		..	
49	..			..		..		1	1	..		..		..	
48	..			..		..		1			1	..		..	
47	..			..		..		1	2	1	1	..		..	
46	..			..		..		2	4		1	..		..	
45	..			..		..		6	1		1	..		..	
44	..			..		..			1	..		..		..	
43	..			..			2	3	2	..		..		..	
42	..			..		2		1	5	..		..		..	
41	..			..			5	3	4	..		..		..	
40	..			..		3		2		..		..		..	
39	..			..		4	1		2	..		..		..	
38	..			..		6	4	1		..		..		..	
37	..			..		8	10	1		..		..		..	
36	..			..		3	5		1	..		..		..	
35	..			..		7	3	..		..		..		..	
34	..			..		5	4	..		..		..		..	
33	..			..		4	2	..		..		..		..	
32	..		2	1		2		..		..		..		..	
31	..		4	3		3	2	..		..		..		..	
30	..		3			1		..		..		..		..	
29	..		4	1		..		..		..		..		..	
28	..		9	4		..		..		..		..		..	
27	..		6	2		..		..		..		..		..	
26	..		4			..		..		..		..		..	
25	..		4	3		..		..		..		..		..	
24	..		1	2		..		..		..		..		..	
23	1		3	2		..		..		..		..		..	
22	..		..			..		..		..		..		..	
21	..		..			..		..		..		..		..	
20	1		..			..		..		..		..		..	
19	3		..			..		..		..		..		..	
18	1		..			..		..		..		..		..	
17	1		..			..		..		..		..		..	
16	..		..			..		..		..		..		..	
Average length..	19.3		27.6	27.2		36.0	36.9	44.0	43.4	50.5	47.6	58.0		84.0	
	19.3		27.5			36.4		43.7		48.4					

length 27,5 cm., annual increase 8,2 cm. — The III-group is the most numerous and ranges from 30 to 43 cm.; mean length 36,4 cm., annual increase 8,9 cm. — The IV-group is varying in length from 36 to 51 cm.; average length 43,7 cm. and annual increase 7,3 cm. — The V-group is very scarce, ranges in length from 45 to 54 cm.; average size 48,4 cm., annual increase 4,7 cm. — The other groups do not come into consideration; grown-up fish is nearly absent.

From the following table, where in the contents of Table 5 are summarized, it will be noticeable that the fish from the North coast is, as far as the material is comparable, considerably behind that from

Age groups	0	I	II	III	IV	V
Variation in length	(1—4)	17—23	23—32	30—43	36—51	45—54
Average length	abt. 2.5	19.3	27.5	36.4	43.7	48.4
Average annual increase	..	abt. 17	8.2	8.9	7.3	4.7

the warmer waters on the South—North-west coast as to the speed of growth, especially in the second to the fifth year. Unfortunately I can make no comparison for older fish, as this is nearly completely absent, but the results of these investigations of mine agree fairly well with those made by THOMPSON on four years old fish captured off Langanes[1].

ε. The East coast.

The material from this section only embraces scales from abt. 110 fish, collected at Nordfjord in the first week of August 1920. The particulars are put down in the following Table 6.

As in the case of the material from most of the other districts the 0- and the I-group are entirely absent, and this is also the case with the III-group. This was not to be found in 1920 at the time recorded, neither on the East coast nor in Eyjafjord[2]. Last summer I succeeded in completing the material as to the North coast (see above), but the "Dana's" short stay on the East coast did not permit the same for that coast. But taking the particulars given in the Table into consideration I shall remark, that the absence of the 0-group is due to the circumstance that the pelagic fry of the Haddock hardly has reached this coast and still less commenced the bottom-life in the coastal waters and in the fjords at the time in question[3]. — The I-group is also lacking in the material but this makes no difference, for big catches, doubtless of this group (and older) have been made onboard the "Thor" with eel-seine and trawl on her cruises in these tracts in the years 1903—05. E. g. 1375 Haddocks ranging in length from 12 to 20 cm., mean size abt. 17 cm., were taken with eel-seine in Seydisfjord, July 28th 1905 and 1205 13—20 cm. long fish in mean abt. 16 cm. with trawl in Vopnafjord the next day (see Catch-record I, p. 25). — The II-group (exclusively taken at 15—20 m. depth in the fjord) varies in length from 20 to 31 cm., average length 25,4 cm. and the average annual increase abt. 9,0 cm. — The III-group is, as mentioned above entirely absent, but in a catch made by the "Thor" in Lodmundarfjord, July 27th 1904 a numerous group, ranging in length from 32 to abt. 44 cm. is very conspicuous (see Catch-record H, p. 25) and must be looked upon as the group in question; the average size is abt. 36 cm. and then the annual increase should be abt. 10,5 cm. — The IV-group is like the other remaining groups rather scarce, ranges in length from 41 to 50 cm.; average length 46,7 cm. and the annual increase abt. 10 cm. — The

trawl) great quantities of small- and medium-sized Haddock at 4—5 stations at 7 to 50 m. depth, July 25th—28th last summer. A full account of these catches is given later on (Catch-record F, p. 25) and if this is compared to the contents of the Table 5, it will turn out, that the fish belongs to the same age-groups (II—V-gr.).

[1] Problems etc. p. 63—64, Tables 12—13.

[2] A couple of days before my arrival at Svalbardseyri a lot of Haddock, probably belonging to the III-group (32—35 cm) had been caught there.

[3] Cfr. SCHMIDT, The Distribution of the pelagic fry and the spawning regions of the Gadoids in the North Atlantic, from Iceland to Spain, Kh. 1909, p. 53, Chart X.

Table 6. Haddock from the East coast. Nordfjord, August 1920.

Age groups	II		III		IV		V		VI		VII		VIII		IX		X	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Length cm																		
78	..		..		..		..		..		..		..			1	..	
77	..		..		..		..		..		..		..			1	..	
76	..		..		..		..		..		1		..		..		..	
75	..		..		..		..		..		..		..		..			1
74	..		..		..		..		..		1	1		1	..		..	
73	..		..		..		..		..		1	1	..		..		..	
72	..		..		..		..		..		..		..		..		..	
71	..		..		..		..		..		1		..		..	..	..	
70	..		..		..		..		..		..		..		..		..	
69	..		..		..		..		..		..		..		..		..	
68	..		..		..		..			1	1	1	2		..		.	
67	..		..		..		..		..		..		..		..		.	
66	..		..		..		..		..		1		..		..		..	
65	..		..		..		..		1	1		1	..		..		..	
64	..		..		..		..		1		..		..		..		..	
63	..		..		..		..		..		..		..		..		..	
62	..		..		..		..			2	..		..		..		..	
61	..		..		..		..			1		1	..		..		..	
60	..		..		..		..		..		..		..		..		..	
59	..		..		..			1	..		..		..		..		..	
58	..		..		..		..		..		..		..		..		..	
57	..		..		..		..		..		..		..		..		..	
56	..		..		..		..			3	..		..		..		..	
55	..		..		..		1	1	..		..		..		..		..	
54	..		..		..		..			1	..		..		..		..	
53	..		..		..		1	1	..		..		..		..		..	
52	..		..		..		..		..		..		..		..		..	
51	..		..		..		..			1	..		..		..		..	
50	..		..			1	1		..		..		..		..		..	
49	..		..		3	1	..		..		..		..		..		..	
48	..		..		2	1	1		..		..		..		..		..	
47	..		..			1	..		..		..		..		..		..	
46	..		..		3	1	..		..		..		..		..		..	
45	..		..		1	2	..		..		..		..		..		..	
44	..		..			1	..		..		..		..		..		..	
43	..		..		..		..		..		..		..		..		.	
42	..		..		..		..		..		..		..		..		.	
41	..		..		1		..		..		..		..		..		..	
40	..		..		..		..		..		..		..		..		..	
39	..		..		..		..		..		..		..		..		..	
38	..		..		..		..		..		..		..		..		.	
37	..		..		..		..		..		..		..		..		.	
36	..		..		..		..		..		..		..		..		..	
35	..		..		..		..		..		..		..		..		..	
34	..		..		..		..		..		..		..		..		..	
33	..		..		..		..		..		..		..		..		..	
32	..		..		..		..		..		..		..		..		..	
31	1		..		..		..		..		..		..		..		..	
30	..		..		..		..		..		..		..		..		..	
29	2		..		..		..		..		..		..		..		..	
28	3		..		..		..		..		..		..		..		..	
27	11		..		..		..		..		..		..		..		.	
26	9		..		..		..		..		..		..		..		..	
25	13	1	..		..		..		..		..		..		..		..	
24	7	1	..		..		..		..		..		..		..		..	
23	4	1	..		..		..		..		..		..		..		..	
22	2		..		..		..		..		..		..		..		..	
21	..		..		..		..		..		..		..		..		..	
20	2		..		..		..		..		..		..		..		..	
19	..		..		..		..		..		..		..		..		..	
18	..		..		..		..		..		..		..		..		..	
Average length	25.4	24.0			46.7	46.7	51.5	55.7	64.5	59.1	71.3	68.2	68.0	74.0		77.5		75.0
	25.4				46.7		53.3		60.0		69.9		70.0					

V-group (6 specimens only) varies in length from 48 to 59 cm.; mean size 53,3 cm.; annual increase 6,6 cm. — The VI-group ranges from 51 to 68 cm.; average size 60,0 cm. and the annual increase 6,7 cm. — The VII-group ranges from 61 to 76 cm.; average length 69,9 (pretty high); annual increase 9,9 cm. — The remaining groups are too poor for further consideration.

The following summary will show the particulars given above more clearly.

Age groups	I	II	III	IV	V	VI	VII	VIII
Variation in length	(12—20)	20—31	(32—44)	41—50	48—59	51—68	61—76	68—74
Average length	abt. 16.5	25.4	abt. 36.0	46.7	53.3	60.0	69.9	70.0
Average annual increase	..	abt. 9.0	abt. 10.5	abt. 10.0	6.6	6.7	9.9	..

If the fish from this section of the coast is compared with that from the other sections, it will appear, that they follow the fish from the North coast, as to the speed of growth and the growth is even slower still, at least in the first three groups, and this should be the natural consequence of the low temperature predominant in these waters, which is lower than on the other coasts of the country[1]. Surely the figures for the groups IV and V seem to indicate the opposite fact, being higher than those for the North coast, but this must be due, I suppose, to scarcity of material.

d. Summary.

Now that I have given special accounts of the age and size of the haddock from the different sections of the coast of Iceland it remains to summarize the results for clearer comparison, but only the average length (or mean size) and the age-groups up to the VII-group (incl.) will be dealt with, the variation in length, the average annual increase and the rather scarcely represented higher age-groups being left out of consideration. This general-summary is as follows:

Age groups	0	I	II	III	IV	V	VI	VII
S.-coast	abt. 5.0	abt. 20.0	30.7	42.2	49.0	54.9	64.1	67.2
SW.-coast	abt. 5.0	abt. 21.5	abt. 35.0	41.6	50.6	56.9	62.3	76.0
NW.-coast	abt. 5.0	abt. 18.0	32.4	46.1	53.7	62.0	65.7	68.3
N.-coast	abt. 2.5	19.3	27.5	36.4	43.7	48.4	..	..
E.-coast	..	abt. 16.5	25.4	abt. 36.0	46.7	53.3	60.0	69.9
Mean size	abt. 4.4	19.1	30.2	40.5	48.7	55.1	63.0	70.4

As has been stated previously this summary notwithstanding some irregularities, presumably due to insufficient and heterogeneous material, makes clear that the growth of the Icelandic Haddock is on the whole subject to a similar rule as that of the Cod: it is most rapid on the South and the West coast and gradually decreases as we turn to the right round the country, being slowest on the East coast, a fact also stated by THOMPSON[2]. But by closer examination it is noticeable that this decline in growth is proportionally much less in the case of the Haddock, where the difference in the 0-group probably rises to 100 % in the I—II-group to 20—30 % in the two next abt. 20 % and only some 5—10 % or still less in the older (mature) groups, ɔ: finally the difference is eliminated and the fish reaches the same size at a certain age, irrespective of where grown up, and mixes together under the same conditions on the spawning grounds on the South- and South-west coast. This gradually declining growth is most conspicuous in the II-group and doubtless, as previously stated in the case of

[1] Cfr. the Author: Age and Growth of the Cod, p. 28, footnote.

[2] Problems etc., Table 12—13, and Haddock Biology II, p. 32—37.

the Cod (op. cit.) a consequence of the fall of the temperature in the above said direction. Like on the Cod and many other fishes the low temperature on the North- and the East coast has the influence on the Haddock, that no spawning can take place on that side of the country[1].

In the diagram Fig. 3. I have attempted to give a graphical picture of the above recorded growth of the Icelandic Haddock. It must be born in mind that it is, like the survey above based upon measurements carried out mostly in the latter half of July and in the first half of August and is referred to the beginning of the latter, when the fish in question has advanced two-three months into the next year of its life. I hardly need to emphasize that I myself, for reasons given in my treating of the Cod, consider this picture no more than a mere experiment to give the growth of this fish a graphical expression.

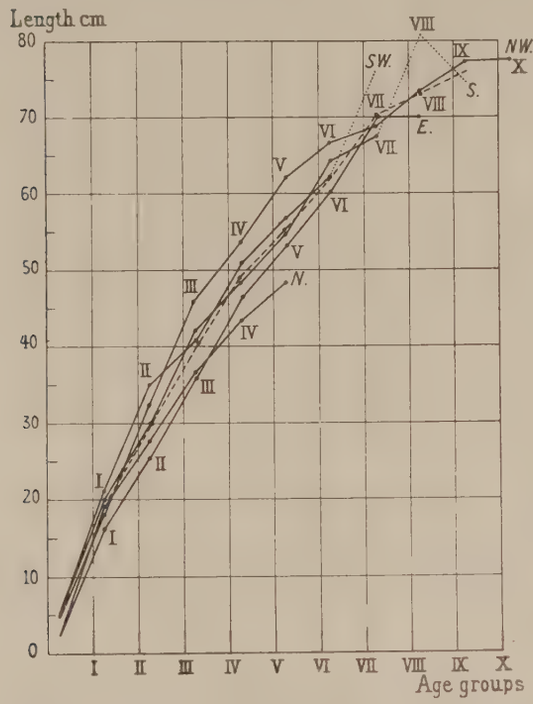

Fig. 3. Growth curves for Haddock from different sections (S., SW., NW., N. and E.) of Iceland. The coarsely broken line is the mean curve.

2. Seasonal changes in the Growth.

As to the seasonal changes in the growth I can state, that the annual spurt of growth sets in at rather a different time in the warm and the cold water. On the South and South-west coast it must, according to my examining of scales from fish captured in April and May, begin sometime late in April or early in May, it reaches its maximum in August—September[2] and then gradually diminishes during October and November; when the rows of broad summer-sclerites gradually change into narrow rows of winter-sclerites of which there can be formed 3—5 at the beginning of December in 2—4 years old fish, fewer in older. In the next warm season the growth seems to set in pretty suddenly, with broad rows of sclerites as a direct continuation of the narrow winter-rows. Thus the limits between two year-zones become as a rule pretty clear or distinct (see the following table and Fig. 2). — In the colder water on the North and the East coast the summer-growth hardly begins before the middle of June and only in the case of the younger age-groups, while the older ones first seem to begin one month later, ɔ: abt. the middle of July. At that time the younger fish have already added some 2—3 rows of broad summer-sclerites to the winter-rings, whereas the older ones only have reached so far as to form one half row or none at all (see following table).

Owing to lack of material I can not tell when the summer-growth ceases in these districts, but according to the prevalent temperature here, it should be at about the same time as in the warmer water or a little later.

As to the rate of growth in comparison with that in other regions, the Icelandic Haddock is second to none except the Faroese, and surpasses by far the Haddock from more southern waters, as the waters West of the British Isles, the North Sea and the Skager Rack[3], but as the matter is thoroughly treated

[1] Cfr. Schmidt: Fiskeriundersøgelser etc., p. 49, Tavle III and The Distribution of the pelagic fry and the spawning regions of the Gadoids etc., p. 51, Charts III and X.

[2] This seems to agree fairly well with the results of the surveying of the temperature in the sea at a selected Station in Faxa Bay, carried out last summer and autumn by the "Dana" and Danish patrolling vessels: Schmidt tells me (in litteris) that the maximum of temperature in the sea turns out to be in September, whereas that of the temperature in the air falls in July.

[3] Cfr. Beretning om Undersøgelser over Torskearternes Naturhistorie. Bergen 1909, p. 68 ff.

Locality	Date	Age groups	Number of rows of sclerites[1]) in each year-zone.
Stokkseyri	$^{17}/_{7}$ 1917	V	18 (10 + 8), 17 (12 + 5), 19 (14 + 5), 18 (13 + 5), 12 (9 + 3), 10.
—	—	IV	16 (10 + 6), 16 (12 + 4), 17 (12 + 5), 15 (12 + 3), 3.
—	—	III	19 (13 + 6), 17 (13 + 4), 18 (13 + 5), 7.
—	—	II	19 (12 + 7), 19 (15 + 4), 4.
Isafjord Deep	$^{28}/_{7}$ 1915	V	15 (8 + 7), 13 (9 + 4), 13 (10 + 3), 13 (11 + 2), 11 (8 + 3), 2—3.
—	—	IV	17 (13 + 4), 15 (14 + 1), 16 (14 + 2), 12 (9 + 3), 3—4.
—	—	III	18 (14 + 4), 19 (14 + 5), 15 (12 + 3), 3—4.
—	—	II	15 (10 + 5), 18 (13 + 5), 4—5.
Skjalfandi Bay	$^{27}/_{7}$ 1924	V	16 (13 + 3), 14 (11 + 3), 12 (6 + 6), 13 (11 + 2), 11 (9 + 2). 0.
—	—	IV	17 (8 + 9), 16 (9 + 7), 14 (12 + 2), 14 (11 + 3), 0.
—	—	III	18 (11 + 7), 14 (12 + 2), 16 (12 + 4), 1.
—	—	II	20 (12 + 8), 18 (13 + 5), 1—2.
Nordfjord	$^{4}/_{8}$ 1920	V	15 (6 + 9), 19 (15 + 4), 12 (10 + 2), 13 (10 + 3), 9 (7 + 2), 1—2.
—	—	IV	17 (13 + 4), 18 (14 + 4), 17 (13 + 4), 18 (15 + 3), 4.
—	—	II	14 (8 + 6), 15 (13 + 2), 2—3.

[1]) The two figures in brackets indicate the number of respectively summer- and winter-rows.

by THOMPSON[1] I can rest satisfied with referring to this paper. Not only the growth of the Icelandic Haddock is very rapid, the size it commonly attains is also very large compared with that in most other regions, a fact THOMPSON has made quite clear (op. cit., Table 18, p. 69), and in accordance to this the age can be pretty high, 10—12 or even 14 years in the case of the largest fish. In the Tables above a good many Jumbo Haddocks, beyond 80 cm. (9—14 years old) are recorded and fish between 70 and 80 cm. (8—10 years old) is pretty common. Until this year (1924) the record-size of the Iceland Haddock was 94 cm., but last winter that record was broken by a 104 cm. long specimen, captured on the South-west coast[2].

3. Sexual difference in size and age.

As when dealing with the Cod I have always, if possible, determined the sex of the Haddock examined, and not only the kind of sex but also the condition of the reproductive organs, especially in fish approaching the age and size of maturity. In the Tables above I have put down the sexes separately in the age-columns. The main results I have recorded in the following survey.

Age groups	II		III		IV		V		VI		VII		VIII		IX		X	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
South coast	30.4	31.1	43.3	40.8	48.3	49.6	54.1	55.4	63.4	64.7		67.2	78.0	79.3	71.0	75.2	..	
South-west coast	35.2	36.4	41.5	41.8	50.1	51.0	56.3	57.7	63.3	62.0	75.0	76.5	..		..		..	
North-west coast	32.0	32.8	45.6	46.7	52.5	54.4	61.4	62.6	66.2	65.3	66.0	69.5	73.1	73.7	75.3	78.4	77.3	77.5
North coast	27.6	27.2	36.0	36.9	44.0	43.4	50.5	47.6	..		..		..		..		..	
East coast	25.4	24.0	..		46.7	46.7	51.5	55.7	64.5	59.1	71.3	68.2	68.0	74.0	..		..	

[1] Problems etc. p. 76, and Table 15.

[2] This "Super-Jumbo-Haddock" was caught in the Midnes Sjór, some 12 miles NW. of Cape Reykjanes and brought to the Fish Market at Reykjavik in February last, but unfortunately I got no news of it before it had been "beheaded" and eviscerated and head and entrails thrown away. I calculated the length to have been 104 cm. and it had weighed 11 kg., its age I could not read with certainty; from some remainders of the sexual organs I judged it had been a male. — Another Giant-haddock weighing 3 kg. split, salted and dried, or about 11 kg. fresh from the sea, has been captured some years ago — I am told — at the Westman Isles.

This summary makes it quite clear, that there is a noticeable difference in the size of the sexes; there are recorded 32 means for males and 33 for females, and in 7 cases only the females are inferior in size to the males, in 1 they are equal, whereas in 27 they are superior. This difference in size appears already in the II-group and continues to the grown-up age. In the IV-group (at the beginning of sexual maturity) it amounts abt. 2 % of the length of the male.

Concerning the age and size at which the Icelandic Haddock grows sexually mature it turns out, from SCHMIDT's and my own investigations that its first beginning takes place in the spring, when the fish (both sexes) is four years old and abt. 47 cm. long, irrespective of on what side of the island the fish spent its first years. Yet not all fish of this age reaches so far, great many grow first mature in the next spring, ɔ: five years old and abt. 55 cm. long, and some few can put it off longer still. I have found virgin females at the age of six years and 55 cm. long. According to the insignificant difference in size of the sexes they seem to grow mature at the very same age. The record of a catch made onboard the "Thor" off Ingolfshöfdi May 25th 1904 (see p. 25) gives a very clear idea of this matter.

4. The weight of the Haddock and the age.

When examining the Haddock and collecting scale-samples I used to weigh every fish, and based upon that material I can give some idea of the proportion between the age of the fish and the weight

1. Size and weight of Haddock from the North-west coast (cfr. Table 4, p. 14).

Age in years	Number of specimens	Variation of		Average	
		length cm	weight g	length cm	weight g
11	3	79—85	5000—6000	82.3	5500
10	10	73—84	4200—5700	77.4	4500
9	19	72—87	3000—6300	77.4	4100
8	25	65—83	2800—5300	73.5	3900
7	17	60—75	2100—5400	68.3	3300
6	10	63—68	1800—4200	65.7	2900
5	23	55—69	1400—3600	62.0	2000
4	35	43—68	900—3000	53.7	1600
3	58	37—56	300—1650	46.1	1000
2	19	29—35	200— 400	32.4	350

2. Size and weight of Haddock from the East coast (cfr. Table 6, p. 18).

Age in years	Number of Specimens	Variation of		Average	
		length cm	weight g	length cm	weight g
9	2	77—78	3500—4400	77.5	4100
8	3	68—74	3500—3900	70.0	3400
7	10	61—76	1900—4000	69.9	3000
6	8	51—68	1800—3900	60.0	2700
5	11	48—59	1200—2000	53.3	1500
4	18	41—50	600—1250	46.7	1000
3[1])	86	32—44	*250—*880	36.4	*500
2	58	20—31	100— 280	25.4	150
1[2])	1375	12—20	*10— *50	16.5	*40

[1]) North coast, cfr. Table 5. [2]) Thor's catch, Seydisfjord. * Approximate.

attained at the age concerned. But as in the case of the Cod I am unable to give a full account of the examinations, as I have had no time to calculate the exact mean values for the particular year-groups, the sexes or even for the different divisions of the coast. Instead of doing so I shall elect the material from the two opposite (warmer and colder) sides of the country, ɔ: from the North-west and the East coast and in the tables beneath give the figures indicating the variation in weight and (approximately) the mean weight of the special year-groups of the fish concerned.

I remarked, when dealing with the Cod that the weight of fish of exactly the same length can be very different according to the condition in which the fish happens to be when captured. This is of course also the case with the Haddock and is very clearly expressed in the tables above. This difference in condition is as a rule especially very marked in mature fish and in a high degree in the Haddock before and after the spawning (seasonal changes). Recently spent Haddock is often in the spring (May—June) really so lean, that it is hardly edible, and its weight very little in proportion to its length, as will be seen in the following table which deals with the same fish as displayed in the Table 3, p. 13, where a good many large fishes are recorded.

Size and weight of Haddock from the South-west coast all the year round (cfr. Table 3, p. 13).

Age years	Number of specimens	Variation of		Average	
		length cm	weight g	length cm	weight g*
13	4	77—83	3750—4870	78.5	4500
12	3	75—76	4500—5000	75.7	4700
11	7	74—83	2000—6500	78.3	4500
10	5	76—80	4120—5500	76.8	4700
9	13	62—84	2400—5500	72.6	3800
8	7	66—78	2250—4900	70.8	3600
7	7	61—76	2750—4500	71.4	3600
6	13	54—71	1550—3550	62.0	2400
5	22	52—68	1500—3500	60.2	2400
4	27	45—62	1000—3100	52.2	1800
3	81	36—56	450—1600	44.2	1000
2	54	30—44	250—1000	36.8	500
1	43	23—31	125— 250	25.8	200

* The mean figures are smoothed to the nearest hundred.

As will be easily intelligible, the rate of the growth of the Haddock turns out to be fairly similar to that of the Cod, as this has been made good by the author (op. cit. p. 31—32). Obviously the growth follows the same lines in both cases, as will be seen, when the graphs showing the growth curves (op. cit. Fig. 4 and the following Fig. 4) are compared. But as a natural consequence of the slower growth and smaller size (lower age) the Haddock on the whole never attains the great weight of the Cod and is far behind it in that respect at the same age, save for the first 2—3 years, especially when Cod from the warmer waters is concerned. Thus for instance the highest average weight recorded for Haddock, 5500 g. at the age of 11 years, is attained by the Cod when 6 years old only, while Haddock on the whole (both from warm and cold water) agrees fairly well with Cod from the cold water. Yet there is a noticeable difference between Haddock from warm and cold water, the growth of the former being considerably quicker than that of the latter. In the II-group (in the third year) the difference in weight is greatest, abt. 133 %, in the III-group (fourth year) 100 %, in the IV-group (fifth year) 60 %, in the V-

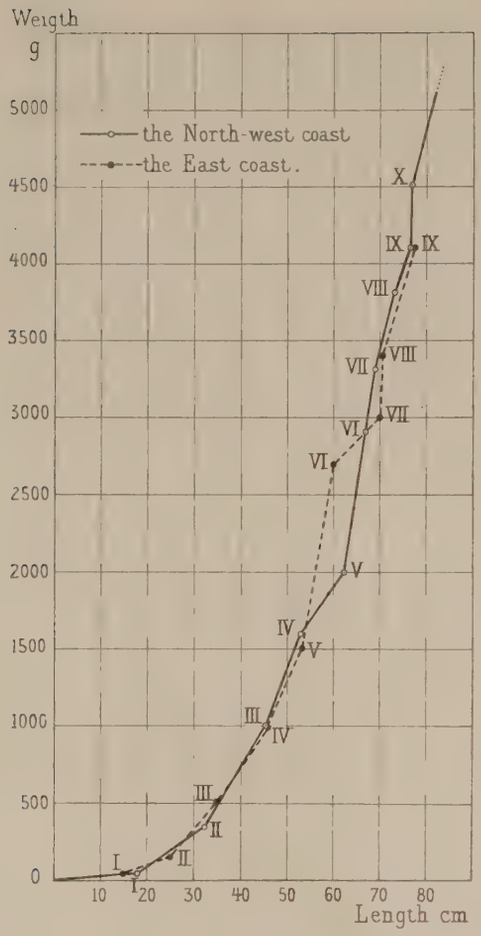

Fig. 4. Approximate weight curves for Haddock.

group (sixth year) 33 %, in the remaining groups 15—0 %, ɔ: at higher age the difference is nearly or entirely eliminated. As a glance at the tables 1 and 2, p. 22, will make the matter quite obvious no further remarks are necessary.

5. The age of the Haddock and the fisheries.

In the final section of my often referred to paper on the Cod I shortly touched on the importance of the fisheries of that fish and tried to make clear the relation between the age of the fish and the fisheries and the influence of them on the different age-groups. This I also wish to do with the Haddock, but as far as this fish is concerned, the material at my disposal and necessary for the purpose is not as rich as was that of the Cod.

In the beginning of the treatment of the Haddock I hinted at the importance of this fish for the natives of Iceland, for which reason I now can limit my account of the matter to stating the fact that the fishing of this fish is carried out all round the country, by open boats and motor boats, with long lines (hooks No. 7—8) and in the last two-three decades by steam-trawlers (native and foreign) outside the territorial limits, but not to the same extent nor in the same season, owing to the fact, that the Haddock is a migratory fish, like the Cod and many others and for the same reason: spawning in the warmer water on the South and West coast[1] in the spring and subsequent wide spread wanderings to the colder waters on the North-west, North and East coast to get food. On the South and the West coast it is captured nearly all the year round, during the winter-season (January—April) exclusively large (mature) fish, on offshore grounds with deeper (80—150 m.) water (see Catch-record A, p. 25), in the late spring (May—June) in shallower water, where the spent fish seeks to regain its good condition by gorging on the enormous shoals of the Lesser Sandeel, which visit the shallow inshore waters with sandy bottom during the warmer season (see Catch-records B, C, D, p. 25). Later on this large fish moves for the greatest part from these tracts to deeper or more distant waters, whereas the medium-sized and small fish refill the inshore grounds and give rise to the summer- and autumn-fishing (see Catch-record E, p. 25) untill the large fish reappears towards the close of the autumn. — On the North and East coast again, in accordance with the above said, the large Haddock usually appears on the offshore grounds in June or July, a couple of weeks after the Cod (as a consequence of its later spawning), where Sandeel (not so numerous here as on the South and West coast) small Capelin (*Mallotus*) or various Invertebrates make out its food, or join in shallower water the younger year-groups which presumably have stayed there since their immigration as pelagic fry in their first summer (see catch-records F, G, H, I, p. 25 and the Tables 5 and 6, p. 16 and 18). In these tracts the large fish sojourns, until they sometimes in the autumn, accompanied by fish, now growing mature, leave these regions for revisiting their spawning grounds. Consequently here (as in the case of the Cod) a dead period extending over some 6—7 months follows[2].

[1] Cfr. Schmidt: The Distribution of the pelagic fry etc. p. 53—54. Charts III and X.
[2] See also the author: Áhrif árstíðanna á líf nytsemdarfiska vorra. Ægir XI, p. 51.

Catch-records A—C.

cm	A	B	C
90	..	..	1
89	..	..	..
88	..	..	3
87	..	..	..
86	..	1	2
85	..	..	1
84	..	..	1
83	..	..	7
82	1	1	13
81	1	1	11
80	..	..	24
79	..	..	21
78	1	5	33
77	2	3	24
76	1	2	37
75	1	1	42
74	2	7	48
73	3	7	39
72	5	3	41
71	1	4	45
70	2	6	31
69	3	9	31
68	3	5	39
67	2	7	43
66	3	6	49
65	3	8	79
64	5	11	50
63	6	15	46
62	8	13	40
61	6	12	41
60	4	12	37
59	7	24	24
58	6	16	21
57	13	15	7
56	6	12	9
55	7	13	1
54	8	11	1
53	6	11	3
52	7	13	2
51	8	6	2
50	11	3	
49	9	5	
48	10	2	
47	4	4	
46	8	1	
45	5	7	
44	5	3	
43	2	5	
42	6	3	
41	1	2	
40	1	..	
39	3	..	
38	3	..	
37	3	5	
36	2	..	
35	1	3	
34	1	5	
33	1	2	
32	2	3	
31	..	3	
30	2	1	

Great many 40—50 cm in July—August

A. "Thor" St. 137 $^{12-13}/_{6}$ 1904. Isafjord Deep 115—122 m. Ottertrawl.

B. Hull Trawler off Ingolfshöfdi, 86 m. $^{25}/_{5}$ 1904. Surveyed by Schmidt.

C. Open boats Faxa Bay abt. 40 m. $^{30}/_{5}$—$^{7}/_{6}$ 1904. Long lines.

Catch-record D.

cm	males a	males b	males c	females a	females b	females c	Sex?
81		..			1	1	..
80		1	1	2		2	..
79	2		2	1		1	..
78	2		2		..		..
77	2		2		..		..
76	3		3	2		2	..
75	8		8	2		2	..
74	6	1	7	2		2	..
73	4	2	5	3		3	..
72	1	1	2		..		..
71	3	3	6	2		2	..
70	6	2	8	2	1	3	..
69	2		2	1		1	..
68	4	4	8	3		3	..
67	4	2	6	4		4	..
66	3	4	7		2	2	..
65	3	2	5	2		2	..
64	4	5	9	2	2	4	..
63	6	3	9	4	2	6	..
62	11	4	15	2	3	5	..
61	8	4	12	3	2	5	..
60	11	9	20	2	4	6	..
59	5	6	11	3	4	7	..
58	12	10	22	2		2	..
57	10	14	24	4	4	8	..
56	7	17	24	3		3	..
55	13	11	24		1	1	..
54	10	11	21	1	2	3	..
53	7	2	9	2	1	3	..
52	6	8	14	2	1	3	..
51	8	5	13		..		..
50	2	6	8		3	3	..
49	4	6	10		1	1	..
48	3	2	5	1		1	..
47	2	2	4			1	..
46			3			2	..
45			4			2	..
44			9			4	..
43			10				..
42			6			3	..
41			4			2	..
40			5			2	..
39			1			2	..
38			5			1	..
37			1				1
36			3				1
35			3			4	2
34			5			7	..
33			8			9	4
32			9			16	5
31			13			6	4
30			8			5	2
29			3			3	3
28		..			..		..
27		..			..		..
26		..			..		..
25		..			..		1
24		..			..		..
23		..			..		1
22		..			..		4
21		..			..		10
20		..			..		36
19		..			..		66
18		..			..		136
17		..			..		135
16		..			..		98
15		..			..		34
14		..			..		14
13		..			..		5

Immature (males) / Immature (females) / I

"Thor" St. 115 $^{24}/_{5}$ 1904. Off Ingolfshöfdi 48—75 m. Ottertrawl *a*, running milt or roe, *b*, not running, *c*, total.

Catch-records E—I.

cm	E	F	G	H	I
83	..	..	..	1	..
:	..	..	..	..	..
65	..	..	..	1	1
64	..	..	..	..	..
63	..	..	..	..	..
62	..	..	..	1	2
61	..	1	..	3	4
60	..	..	..	5	1
59	..	..	..	8	2
58	..	..	..	7	1
57	..	..	..	13	1
56	1	1	..	11	1
55	..	..	..	9	..
54	1	3	..	7	1
53	..	2	..	6	1
52	..	1	..	3	1
51	..	3	..	4	..
50	1	7	..	4	..
49	4	4	..	3	..
48	10	5	..	6	..
47	11	14	..	10	..
46	14	9	..	4	..
45	8	13	..	10	..
44	9	9	..	4	..
43	7	7	..	4	..
42	2	10	..	6	..
41	1	17	..	6	..
40	..	25	..	5	..
39	9	42	..	7	..
38	28	60	..	7	..
37	85	73	..	20	..
36	188	79	..	13	..
35	447	68	..	16	..
34	447	64	..	12	..
33	526	49	..	4	..
32	434	46	..	2	..
31	252	61	..	..	..
30	116	87	..	..	3
29	53	128	..	..	..
28	18	194	..	..	3
27	13	215	..	..	2
26	9	222	..	..	2
25	7	211	..	..	4
24	13	120	..	..	2
23	97	72	..	..	1
22	205	18	..	..	..
21	499	10	..	..	1
20	755	1	3	..	12
19	684	1	20	..	52
18	311	..	80	..	179
17	99	..	282	..	375
16	19	1	474	..	384
15	10	2	380	..	178
14	10	..	114	..	46
13	1	..	21	..	9
12	.	..	1	..	..
11	1	..	..	..	..

II / III / IV / I

E. "Dana" St. 2169 $^{6}/_{7}$ 1924, Faxa Bay, 34—36 m. Ottertrawl.

F. "Dana" St. 2205, 2208, 2209 $^{25-27}/_{7}$ 1924, Skjalfandi Bay, 15—50 m. Ottertrawl.

G. "Thor" St. 135 $^{28}/_{7}$ 1905. Seydisfjord, Eel-seine.

H. "Thor" St. 218 $^{27}/_{7}$ 1904, Lodmundarfjord 30 m. Long line.

I. "Thor" St. 138 $^{28}/_{7}$ 1905, Vopnafjord, 10—20 m. Ottertrawl.

Now it only remains to draw up the relation between the fisheries and the age of the fish or, more clearly speaking to sketch the influence of the fishing on the different age-groups (sizes of the fish). And it must be remembered that the fishing implements in question nearly exclusively are, as mentioned above the longline and the otter-trawl. The relatively few fish caught in cod-gillnets or drag-seines and the Danish seine is not much used or in certain districts prohibited (the South corner of Faxa Bay).

The 0-group is out of question as this seeks the bottom in relatively deep water and is too small sized to be captured by any of the fishing apparatus. — The I-group does not as a rule stay in very shallow water nearest to the shores, but is very numerous on the shallow grounds (10—50 m. depth) a little farther off. In the first half of the summer many of them can, thanks to their smallness, escape through the meshes of the trawl, and on the other hand the baited line-hooks are too big for their little mouths. But later in the summer they are grown so large, that these chances of avoiding the peril are annihilated, and they can easily be captured (not in great quantities though) by the implements mentioned (see catch-record E, p. 25). — The II-group again is highly exposed to the danger caused by the fishing

Table a. Periodical mean native catches of Haddock, Iceland 1913—1919 and year catches 1919—20.

Period	Number of fish in 1000
1897—1900.....	4972
1901—1905.....	4223
1906—1910.....	2546
1911—1915.....	2175
1916—1919.....	3444
1919.....	4419
1920.....	3425

Table b. Total native-catches of Haddock, Iceland, 1913—20.

Year	Total catch in 1000 kg
1913.....	3677
1914.....	2690
1915.....	4500
1916.....	5780
1917.....	6001
1918.....	6559
1919.....	8646
1920.....	7600

gear, especially to that from the trawl, where the fish happens to live outside the territorial limit and come in its way. — Concerning the older groups any further remarks are hardly necessary. They are captured on a large scale by native and foreign fishermen all round the coast, but the number of the individuals of the various age-groups diminishes in a reverse proportion to the age, as will be seen from the catch records above, ɔ: only proportionally few fish reach the highest age.

Thus the same seems to turn out to be the rule concerning the capture of the Haddock as of the Cod (op. cit., p. 34): The majority of the captured fish in Icelandic, especially the shallower inshore waters is young immature fish. Still no decreasing of the stock of the fish is noticeable as show the means for every 5 years from 1897 to 1919 and the figures for 1919 and 1920 separately in the above table, taken from the Icelandic Statistics[1] and the annual catches for 1913—20, taken from the International Statistics[2]. The same will also turn out when the foreign fisheries are concerned, as will be seen from the International Statistics. But for more accurate treating of the matter further statistical inquiry would be necessary.

II. The Whiting (Gadus merlangus L.).

1. General remarks.

Whereas the Cod and the Haddock are two of the most valuable of the Icelandic food fishes, the Whiting (Icelandic: lýsa) is one of the most insignificant, which has no separate place in our Statistics,

[1] Fiskiskýrslur og hlunninda 1920, Reykjavik 1923.
[2] Bulletin Statistique, 1919—20, Vol. XI, p. 109. Copenhagen 1924.

being put down under the head: Other fish, nor is this fish much appreciated as food by the Icelanders and gives rise to no special or important fishery. Its principal habitat is the warmer water on the South- and the Southwest coast where it is fairly common and where the spawning is carried out, and from there the pelagic fry is partly carried by the currents northward and eastward to the North-west, the North and the East coast[1]. The youngest age-groups are fairly common in the fjords on those coasts during the warmer season where they are leading a semi-pelagic life chasing their prey, often in quite shallow water of 0—20 m. depth, but they are — and so are also the medium-sized groups — rather unstable in their appearance, being abundant one year, entirely absent another. The stay of this fish in the colder water is mainly limited to the 2—3 first years of their age; by approaching maturity they seek back to the warmer water, where the grown-up fish takes a permanent stay, and on the whole leaves the shallower coastal grounds and moves to deeper (80—100 m.) water offshore[2].

2. Collection of Material.

As any noteworthy fishing of the Whiting only is carried out on the South and the South-west coast, I have limited my collecting of material to that division of the coast. From Faxa Bay I got some 30 samples at Akranes in July 1917 and abt. the same number onboard the "Dana" in the same month 1924. But the bulk of the material samples from abt. 160 specimens I collected at Stokkseyri (on the South coast) in July 1917. From that place and the neighbour-place, Eyrarbakki, a good lot of large whiting is frequently captured on longlines from open boats at the end of the spawning period (June—July) when the fish uses to visit the shallow water in the vicinity of the coast[3].

The material consists of samples of scales from abt. 250 fish of all ages from the 0-group upwards, in some few cases I also took the otoliths. For age-determination of the Whiting the scales are doubtless the most convenient objects, being easy for collecting and preserving, whereas the otoliths as usually give more trouble for collecting and are fragile too, owing to their prolonged shape. Other objects, as the basal bones of the paired fins, the vertebræ etc. may also prove fit for the purpose; I have made no use of them.

According to the above said my principal material for the age-determination have been the scales, which when possible have been taken from the middle of the sides of the fish and preserved and examined in the same manner, as when dealing with the Haddock. The reading of the age has as a rule not proved to be difficult, at least not as far as the younger scales are concerned. Yet the great number of winter-rings, which as a rule gradually broaden and thus effaces the limits between winter- and summer-zones, may sometimes render the reading uncertain especially in the case of older scales; yet in such cases the probable error seldom will exceed one year. In the first summer-zone pretty frequently a considerable number of narrow rings will assume the aspect of a winter-zone, which hardly can be expected, where only 2—3 broad summer-rings separate them from the centre of the scale (Fig. 5). This false winter-zone could be looked upon as a consequence of some change in the life of the fish, e. g. moving from shallower to deeper (or cooler) water[4], sometimes in the latter part of the summer, or the transition from pelagic to bottom life, as the scales already are formed, when the fish has attained the length of 5 cm., and perhaps is still living pelagically, and has already got 2—3 rows of sclerites in specimens 5—7 cm. long[5]. True secondary rings, consisting of one or two rows of sclerites, not seldom occur in one

[1] Schmidt: The Distribution of the pelagic fry etc. p. 58, Chart IV.

[2] Idem: Fiskeriundersøgelser etc. p. 84. The Author: Oversigt over Islands Fiske, p. 51—52.

[3] See the Author: Fiskirannsóknir 1919—20. Andvari XLVI, p. 69—73.

[4] Cfr. Thompson, Problems etc., p. 13.

[5] Perhaps these narrow rings could be regarded as a true winterzone due to the fact, that either the specimen in question had spent its first year in the colder water or if not then had been hatched so late that no time had been to form more than some very few rows of summer-sclerites. But as the phenomenon is pretty common in fish on the South- and South-west coast, only measuring 17—18 cm. at the middle of July (and that hardly can be regarded as two years old) and markedly variable in the same specimen, I think the above given explanation is the most probable one.

or more scales in each sample and "blanc" scales with the first and sometimes also the second year's sclerites effaced are pretty frequently met with (in 12—20 % of scales examined).

The number of rows of sclerites in the single year-zones will be seen in the table p. 31.

Fig. 5 A. Scale of *Gadus merlangus*. I. Gr. 20 cm. Faxa Bay. July.

B. Scale of *Gadus merlangus*. III. Gr. 42 cm. ♂. Faxafloi. 3.-7.-1918.

C. Scale of *Gadus merlangus*. V. Gr. 54 cm. ♂. Stokkseyri. July.

The otoliths of the Whiting differ in a rather high degree from those of the other species of *Gadus*, being relatively very long and the hind part prolonged into a pretty long and sharp-edged point, exhibiting the shape of a knife-blade with the edge (when in situ) turned upward (Fig. 6, B). For the reading of the age the fresh otoliths need no further preparing, but when dried they can be soaked in water, and finally the winter-zones will be so transparent as to appear quite clear in transmitted light or black if the otolith is examined lying on a black preparing slab.

Fig. 6. Otoliths. A *Gadus æglefinus*. B *Gadus merlangus*. Abt. × 2. f fore-end, u upper edge.

3. Treatment of the material.

As the material I have had to treat of for the greatest part is collected on a rather limited stretch of the South and the South-west coast on both sides of the south-western peninsula, the Reykjanes, I find no reason for dividing it into more divisions like that of the Cod and the Haddock and treat each of them separately, but think it more fit to treat it collectively in one Table, save for the few specimens from other parts of the coast, which are excluded. The material is displayed in the Table 7 beneath.

As will be seen by glancing at this Table it embraces representatives for all age-groups from the 0-group to the VIII-group, and gives, I suppose, notwithstanding the paucity of individuals of the 0- and

Table 7. Whiting from the South and South-west coast South coast, July 1917. Faxa Bay, July 1917—24.

Age groups	0	I			II		III		IV		V		VI		VII		VIII	
Sex	♂ ? ♀	♂	?	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Length cm																		
67	..	..			..		..		..		..		..		..		..	
66	..	..			..		..		..		..		..			1		1
65	..	..			..		..		..		..		..			1	..	
64	..	..			..		..		..		..		..		..		..	
63	..	..			..		..		..		..		..		..		..	
62	..	..			..		..		..		..			1	..		..	
61	..	..			..		..		..			1		1	..		..	
60	..	..			..		..		..		..			1	..		..	
59	..	..			..		..		..		..			1	..			1
58	..	..			..		..		..		..			1	..		..	
57	..	..			..		..		..			3	1		..		.	
56	..	..			..		..		..			2	2			1	..	
55	..	..			..		..		..		1		2			1	.	
54	..	..			..		..	3	4	1				2		1	..	
53	..	..			..		..	1	1	1	..				..		..	
52	..	..			..		..	5	2	6	1	2			..		..	
51	..	..			..		..	3	1	7	1				..		..	
50	..	..			..		..	13		3	2	2			..		..	
49	..	..			..		..	2	1	4	..				..		..	
48	..	..			..		..	5	2	1	..				..		..	
47	..	..			..	1	2	3		1	..				..		..	
46	..	..			..	1	5	7	1	1	..				..		..	
45	..	..			..	2	2	3		1	..				..		..	
44	..	..			..	2	5	2		1	..				..		..	
43	..	..			..	..	4	1	..		..				..		..	
42	..	..			..	1	1	3	..		..				..		..	
41	..	..			..	1	6	4	..		..				..		..	
40	..	..			..	1	1	2	..		..				..		..	
39	..	..			..	1	1		..		..				..		.	
38	..	..			..	2	2	..	..		..				..		..	
37	..	..			..	..	.	..	..		..				..		..	
36	..	..			2		1	..	..		..				..		..	
35	..	..			..	3	2	..	..		..				..		..	
34	..	..			..	1	1	..	..		..				..		..	
33	..	..			..	1	1	..	..		..				..		..	
32	..	..			1	2	..	..	..		..				..		..	
31	..	..			..	..	..	..	..		..				..		..	
30	..	..			..	..	..	..	..		..				..		..	
29	..	..			..	..	..	..	..		..				..		..	
28	..	..			..	..	..	..	..		..				..		..	
27	..	..			1		..	..	..		..				..		.	
26	..	..			..	..	..	..	..		..				..		..	
25	..	..			..	..	..	..	..		..				..		..	
24	..	..			..	..	..	..	..		..				..		..	
23	..	1	1		1*)	4*)	..	..	..		..				..		..	
22	..		3	2	1*)		..	..	..		..				..		.	
21	..	1			1*)		..	..	..		..				..		..	
20	..	1	1	2	..		..	..	..		..				..		.	
19	..		1	1	..		..	..	..		..				..		..	
18	..			3	..		..	..	.		.				..		..	
17	..			2	..		..	..	..		..				..		..	
16	..	2			..		..	..	..		..				..		..	
15	..	3		1	..		..	..	..		..				..		..	
14	..		2		..		.	..	..		..				..		..	
13	..		..		..		..	..	..		..				..		..	
12	..		1		..		..	..	..		..				..		..	
11	..		..		..		..	..	..		..				..		..	
10	..		1		..		..	..	..		..				..		..	
9	..		..		..		..	..	..		..				..		..	
8	1		..		..		..	..	..		..				..		..	
7	2		..		..		..	..	..		..				..		..	
6	4		..		..		..	..	..		..				..		..	
5	2		..		..		..	..	..		..				..		..	
Average length	6.2	17.6	17.8	18.7	28.1	26.0	38.3	40.2	45.0	47.6	51.5	51.4	53.6	55.6	59.2		62.5	
		18.1			27.0		39.3		46.6		51.4		54.7					

*) Perhaps belonging to the I-Gr.

the II-groups, a fairly good idea of the growth and the age of the fish in question, as far as the warmer regions are concerned, an idea which finds the clearest expression in the Graph Fig. 7. The growth-curve shown in this Graph is very much of the ideal one.

As regards the special year-groups I will mention that the 0-group is very scarce, being only 9 specimens taken at the Westman Isles and in Faxa Bay in the middle of August, and is for that reason relatively too large, as the mean size is 6,2 cm., but should have been only 3—4 cm. at the time (middle of July) when the other material was collected[1]. — The I-groups (from Faxa Bay only) is pretty well represented, ranges in length from 10 to 23 cm., average length 18,1 cm. and average annual increase (referred to the middle of July) abt. 14,5 cm.[2] — The II-group (also from Faxa Bay only) is very poor, ranges from 21 to 36 cm., average size 27,0 cm. and the annual increase 8,9 cm. — The III-group (most part from the South coast) ranges from 33 to 47 cm., with a mean length of 39,3 cm.; annual increase 12,3 cm. — The IV-group is the most numerous (and for the greatest part from the South coast) ranges from 39 to 54 cm., average length 46,6 cm.; annual increase 7,3 cm. — The V-group (all specimens except two from the South coast) is also fairly abundant, varies in length from 44 to 61 cm., mean length 51,4 cm. and the annual increase only 4,8 cm. — The remaining 3 groups are all scarce and exclusively from the South coast. The VI-group ranges from 50 to 62 cm., mean length 54,7 and the annual increase 3,3 cm. — The VII-group ranges from 54 to 66 cm., average size 59,2 cm. and annual increase 4,5 cm. — Finally the two specimens of the VIII-group have the length of 59 and 66 cm., mean 62,5 and annual increase 3,3 cm.

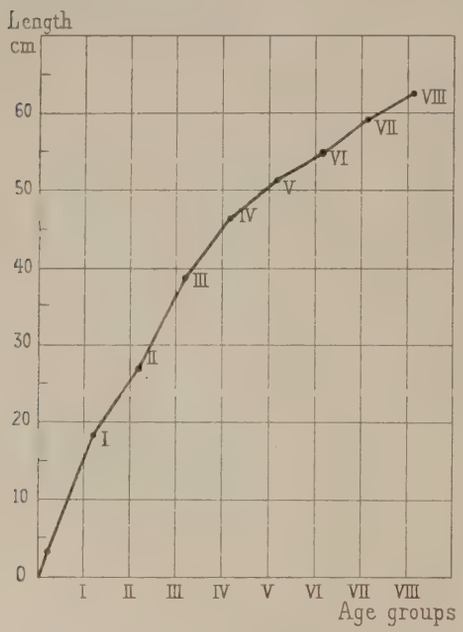

Fig. 7. Growth curve for Whiting. South and South-west coast of Iceland.

The particulars now given in the Table above will be more easily recognisable from the following summary.

It will be seen that the growth is fairly rapid in the first four—five years and then becomes slower by increasing age (irrespective minor irregularities surely due to insufficient material), when the fish has been mature. Further it will be seen that, as far as the youngest groups are concerned, the single groups keep themselves, as to the size, fairly well separate from each other, ɔ: very few only of each of them have the size of those in the neighbour-groups. Firstly in the IV-group the single groups begin interfering with each other in this respect in proportion to the decreasing of the annual growth, surely a consequence

Age groups	0	I	II	III	IV	V	VI	VII	VIII
Variation in length	(5—8)	10—23	21—36	33—47	39—54	44—61	50—62	54—66	59—66
Average size	abt. 3.5	18.1	27.0	39.3	46.6	51.4	54.7	59.2	62.5
Average annual increase....	..	abt. 14.5	8.9	12.3	7.3	4.8	3.3	4.5	3.3

of the fact, that all the fish at that age have grown mature (see further pag. 32). Otherwise the rate of growth will be most conspicuous from the Graph Fig. 7.

[1] Schmidt has taken pelagic fry, only 1—4 cm. long at the middle of July on the South coast.

[2] The size of this group in cold water seems not to be much different from this, as Schmidt states (Fiskeriundersøgelser, p. 84) that the mean size of 139 specimens, captured in Seydisfjord July 23th 1903, was abt. 13 cm., and of 15 specimens caught at the same place July 28th 1905 14,3 cm. — In Isafjord Deep I took 6 specimens 12—22 cm. long, mean size 17,3 cm. July 14—27th 1908, all surely belonging to the I-group.

The seasonal changes in growth caused by the annual rising and falling of the temperature in the sea can hardly be sufficiently scrutinized on the pretty one-sided material. On the few samples of one—two-years old specimens from colder water, e. g. from Patreksfjord, Eyjafjord and Seydisfjord already a remarkable growth (2—3 rows of sclerites) has taken place in the first half of July, whereas in the warmer water in Faxa Bay and on the South coast 3—6 rows are formed at that time. In older (4—7 years) fish from these waters very little or no growth (0—1 rows of sclerites) is perceptible (se following table). Perhaps this is a consequence of the fact that the spawning is not over before the middle of July. On the other hand no material is at disposal for fixing the time when the rapid summer-growth ceases.

Locality	Date	Age groups	Number of rows of sclerites[1]) in each year-zone.
South coast	$^{13}/_{7}$ 1917	VII	16 (8 + 8), 13 (9 + 4), 21 (15 + 6), 15 (10 + 5), 10 (6 + 4), 8 (6 + 2), 5 (3 + 2), 0.
—	—	VI	24 (20 + 4), 28 (22 + 6), 18 (13 + 5), 18 (10 + 8), 9 (6 + 3). 5 (3 + 2), 2.
—	—	IV	28 (8 + 15), 22 (15 + 7), 9 (7 + 2), 0.
—	—	III	23 (5 + 18), 16 (14 + 2), 10 (5 + 5), 4.
Faxa Bay	$^{30}/_{7}$ 1918	II	20 (16 + 4), 12 (12 + 0), 0.
—	—	I	16 (8 + 8), 4.
Westman Isles	c. $^{15}/_{8}$ 1899	0	2—3.
Patreksfjord	$^{4}/_{7}$ 1924	I	15 (12 + 3), 2.
Eyjafjord	$^{10}/_{7}$ 1920	III	20 (12 + 8), 10 (7 + 3), 8 (6 + 2), 0.
Seydisfjord	$^{27}/_{7}$ 1903	I	14 (10 + 4), 2—3.

[1]) The two figures in brackets indicate the number of broad and narrow rows respectively.

4. Size and age.

As to the size the Whiting can attain in Icelandic waters this surpasses very considerably that of this fish in the neighbouring seas[1]. In the Table above 6 specimens beyond 60 cm. length are recorded and two of them measure 66 cm., but the largest specimen hitherto surveyed at Iceland (by Schmidt) was 68 cm.[2] Else the common size of the grown-up fish is 40—55 cm.

From the Table it will be seen that the Whiting does not reach any high age; only few of the specimens recorded are six years old; only 5 are (as far as I can read the age correctly) seven and 2 eight years old. Higher age I have not met with and it is probably very rare and I am inclined to suppose that the age of the fish on the whole does not surpass ten years.

5. Sexual difference in size.

In the Table the sexes are, as far as they have been distinguishable, put down separately and the average sizes recorded. The particulars concerning this matter are given in the following summary.

Age groups	I		II		III		IV		V		VI		VII		VIII	
Sex	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Mean size	17.6	18.7	28.1	26.0	38.3	40.2	45.0	47.6	51.5	51.4	53.6	55.6	59.2		62.5	

This summary makes it clear, that there is a marked difference in size between the sexes, the females being a little larger than the males at the same age. This difference is already conspicuous in the second year and continues up through the years, not without some irregularities though, probably

[1] Rosèn and Molander: Havfiskar och havfisken, Stockholm 1923, p. 82.

[2] Research-journal 1905 ("Thor" St. 54, Lons vik).

due to insufficient material (the VII- and VIII-group have no masculine representatives). The difference amounts as a rule only to some 2—6 %. From the Table it will be seen that all the largest fish, 58 cm. or more, are females, and that the majority of the number of fish in the groups IV—VI and all individuals of older fish are of this sex. Thus the females not only are a little larger than the males, but probably also attain a higher age than these — as is the case with the Cod.

Regarding the age (and size) at which the Whiting grows sexually mature I have found by examining the fish surveyed, that the minimal size for both sexes is abt. 40 cm., but SCHMIDT has taken (off Ingolfshöfdi May 25th 1904)[1], some males with running milt down to 27 cm. and females with running roe 31 cm. This small size, which should correspond to the age of 2 years only, must be regarded at the lowest minimum for maturity; as a rule the fish grows mature at the size of abt. 40 cm. when three years old, and the bulk of the spawning fish is four years old (45—50 cm.) or more. On the other hand I have found spawning fish among the largest (oldest) fish examined.

6. The size and the weight.

As when dealing with the Cod and the Haddock I have weighed all Whiting examined, except that surveyed onboard the "Dana", and as far as the material from the South coast is concerned, calculated mean values for every year-group whereas that from Faxa Bay only has permitted some approximate figures[2]. The particulars are given in the table beneath and show very clearly how the weight as usual increases rapidly by increasing length (and age). In accordance with the rather limited size of the fish its maximal-weight does not reach 2,5 kg., but I will emphasize that the large fish making out the material from the South coast has just finished the spawning and for that reason was rather lean and relatively light. Following Graph, Fig. 8 will show the growth-curve based upon the particulars given above.

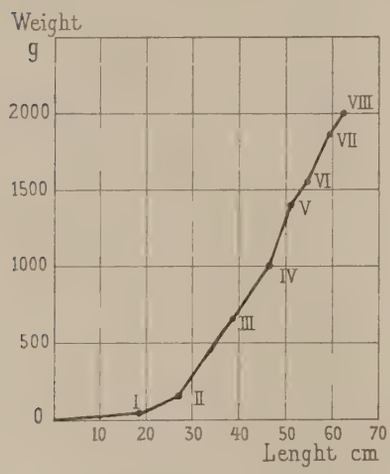

Fig. 8. Weight-curve for Whiting. South and South-west coast of Iceland.

7. The age of the Whiting and the fishery.

As remarked above in the beginning of this section, the Whiting can not be regarded as any valuable food-fish from Icelandic point of view; more important it is for foreign nations, who often take pretty good catches in the trawl on the South coast. In 1919 and 1920 the total foreign catch was respectively 481 and 412 tons[3], but concerning

Age years	Number of specimens	Variation of		Average	
		length cm	weight g	length cm	weight g
8	2	59—66	2000—2000	62.5	2000
7	7	54—66	1500—2300	59.2	1750[1])
6	20	50—62	1100—2100	54.7	1550[1])
5	46	44—61	900—1900	51.4	1400[1])
4	94	39—54	700—1700	46.6	1000
3	30	33—47	290—1100	39.3	650[1])
2	13	21—36	? — ?	27.0	150[2])
1	29	10—23	? — ?	18.1	35[2])

[1]) Smoothed to the nearest 50 g. [2]) Approximate.

[1] Research-Journal 1904.

[2] Cfr. also Fiskirannsóknir 1919—20, Andvari XLVI, p. 70—71.

[3] Bulletin Statistique, Vol. XI, 1919—20, Copenhague 1924, p. 109.

Catch-records J—M.

cm	J	K	L	M	cm	J	K		L
66	..	..	..		32	o	3		3
:	..	..	..		31	♀♂	8		8
57	♀	..	..		30	..	11		12
56	o	..	..		29	♂♂	16		19
55	..	..	..		28	..	21		21
54	..	..	..		27	♂o	23	II	29
53	♂♂	..	..		26	o	18		24
52	♂♂	..	..		25	o	14		15
51	..	..	..		24	o	8		8
50	♂	..	..		23	oooo	5		6
49	..	..	..		22	o	1		4
48	..	..	..		21	oooooooo	1		2
47	..	..	..		20	oo	7		7
46	..	..	..		19	ooooo	2		4
45	♂	..	..		18	ooooo	5		10
44	..	..	..		17	ooooo	11	I	15
43	..	..	..		16	ooooo	5		7
42	♀	..	..		15	ooooo	4		8
41	..	..	..		14	o	5		6
40	..	..	..		13	oo	2		4
39	♂♂	..	..		12	oo	2		4
38	..	..	..		11	o	..		
37	..	..	..		10	..	..		1
36	..	..	..						
35	♀	1	1						
34	♂o	..	..						
33	♀♀♀o	..	..						

Open boats' catches, South coast July 1917

J. "Thor" St. 115 $^{24}/_{5}$ 1904, Off Ingolfshöfdi, 48—75 m. Ottertrawl. ♂♀ running milt and roe.
K. "Thor" St. 37 $^{22\text{-}23}/_{6}$ 1908, Faxa Bay, 34 m. Ottertrawl.
L. "Thor" St. 34 and 37 $^{16\text{-}23}/_{6}$ 1908. Faxa Bay, 34—68 m. Ottertrawl.
M. Open boats, south coast July 1917. Number of fish captured unknown.

the Icelandic fishery no particulars are available. As to the size of the fish taken by foreigners I have no information, but understanding that the capture is carried out outside the territorial limits, I suppose that the catches for the greatest part consist of grown-up fish, like that I myself surveyed on the South coast in 1917, and was taken out of line-catches, composed of mostly 3 to 6 years old fish (see Table 7 and p. 30). Yet "Thor's" catches of trawled Whiting on 50—75 m. depth off Ingolfshöfdi (St. 115, 1904, see Catch-records beneath) and on the same depth and also on 34 m. in Faxa Bay (St. 37 and 134, 1908, see Catch-records J—M.) make clear that lots of immature, 1—2 years old fish also can be captured but the above mentioned unstable nature of the Whiting at this age, being one year abundant, next year quite absent on the same spot may doubtless counteract the depleting influence of the very effective trawl-fishing. Anyhow there are no signs indicating any diminishing of the stock.

Corrigenda.

In my paper on the Age and the Growth of the Cod some errata have slipped in:

Page 10, Table, I-gr. 51 cm. 1, the cipher 1 is to be blotted out.
— 10, Footnote, l. 3: taken in the, should be taken later in.
— 25, Table, 0-gr.: Abt. 10,0, is to be blotted out.
— 29, Table, VI-gr. ♀: 73,8 shall be 75,8.
— 32, Fig. 5, explanation: spent shall be ripe.

550. 14/X. 25.

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